JOURNAL

OF THE

Department of Agriculture

OF

WESTERN AUSTRALIA.

Vol. 11. (Second Series) JUNE, 1934. No. 2.

THE NITROGEN SUPPLY OF AN APPLE ORCHARD.

A Review of the question and description of an experiment conducted in the apple orchard of Mr. J. Cross at Argyle, Western Australia.

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INTRODUCTORY.

The problems of orchard management, particularly those relating to manurial treatments and cultural methods, have received several decades of intensive investigation. Until 1920, the work was carried out principally in the Agricultural Experiment Stations of the United States of America, and consisted generally of long time field experiments in which various manurial treatments and cultural methods were compared. After 30 years of experimenting along these lines it became apparent to investigators that the field experiments did not contribute greatly to the knowledge of the nutrition of fruit trees and that this method of attack would have to be supplemented by careful parallel chemical and physiological studies. The paper by Alderman (1919), summarising the American work by 28 different experiment stations and stressing the inadequacy of the field experiment method, has been referred to in this Journal by the Director of Agriculture, Sutton (1931). The situation regarding the problems of fruit tree nutrition is reviewed by Wallace (1933). It seems that this field work, while yielding little of fundamental significance to the understanding of the fruit tree, has been of importance to the fruit industry in showing the uncertainty of positive results from fertiliser applications over a wide range of soil and climatic conditions; in showing

the importance of proper cultural methods; and in laying the foundations for the newer methods of research in fruit growing. To quote Wallace (1933) :—

> "It will be apparent . . . . that specific recipes for the manuring of fruit can have little practical value. The only sound basis for the intelligent use of manures on fruit trees is a detailed knowledge of the factors concerned in any particular instance.
>
> "Thus he (the farmer) must acquaint himself with the peculiarities as regards nutrition of his various plants, with the effects of special local conditions of climate and soil, and with the reaction of his trees, at various stages, to details of management."

Of the fertilisers, nitrogen has most consistently given positive results in America, and in England, potassium. Mineral fertilisers in general have proved at least equal to organic manures.

The new method of attack involves research into the various phases of fruit tree nutrition.

1. The effect of deficiency of various elements such as nitrogen, potash, magnesium, phosphate, etc., when trees are grown under laboratory and field conditions. The behaviour of the trees under laboratory conditions has been used for the diagnosis of nutritional disorders and deficiencies in the field with an encouraging degree of success.

2. A study of the stock and scion relationships. This has resulted already in the orchardist being able to secure carefully standardised trees and bushes of various types of fruit, thus simplifying many problems in management.

3. The control of quality. Management and manuring practice affect the quality of the fruit. Thus good cider apples are associated with low nitrogen supply and the best vintage fruit is obtained from old trees under grass orchard conditions. Similarly, low cultivation, combined with careful nitrogen fertilisation, is practised to yield best quality dessert apples.

4. The inter-relations of the various essential elements affect the response to fertilisation. It is observed that nitrogen accentuates potassium deficiency and excess nitrogen may lead to the symptoms of potassium starvation in orchards otherwise adequately supplied. Lime may induce chlorosis and, in addition, may lower potassium availability.

It is in the light of this latest information, and using the new methods of horticultural research, that the problems of the fruit growers in this State must be attacked, and the experiment described was arranged to afford data concerning the behaviour of two orchard soils prior to arranging field experiments which must be supplemented by chemical and physiological data. It is confidently expected that co-operation between the growers and the investigators in horticulture will yield information which will assist each individual orchardist to understand more fully his trees and his soils and will lead to improved management and economy in fertilisation.

Fertiliser requirements of the apple tree with particular reference to nitrogen:—

It is apparent that it is exceedingly difficult to determine the fertiliser requirements of the apple tree, and impossible to lay down precise recipes for general use. Individual cases must be treated individually; in fact, in many instances the tree must be regarded as the unit and treatment varied accordingly for best results.

While manurial experiments, particularly in the case of young orchards, have generally given results lacking in uniformity, it is a fact that there is a continual drain on the soil by the growing trees, and care must be taken to maintain and even improve the orchard soils by management and fertiliser practice. Trees may

be slow in showing symptoms of starvation, but they are also slow in recovery; the problem must be anticipated to avoid a lengthy and unprofitable period of recovery.

Gourley (1914, 1919) reported in Gardner, Bradford and Hooker (1922), p. 206, states that his experimental plots in New Hampshire gave no response in yield to fertilisers after five years; and again after 10 years no response in yield was observable but "the orchard is developing in that direction." It seems that, sooner or later, depending on the conditions, fertilisation will be needed in a bearing orchard and the rational management programme involves the use of sufficient fertiliser, economically to maintain the orchard and to avoid otherwise inevitable depletion.

To discuss only the nitrogen requirements, Gardner, Bradford and Hooker (1922), p. 138, state that the nitrogen content of parts of a 30-year old apple tree were as given in Table 1.

TABLE 1.

Nitrogen content of fractions of a 30-year old apple tree.

Fraction.	Total Nitrogen in the Fraction.
	lbs.
Fruit	0·57
Leaves	0·87
New growth	0·03

Another investigator (*ibid.*) found that 1,000 lbs. of fresh apples (fruit) contained 1.05 lbs. of nitrogen.

As the fruit is the only portion removed it is seen that a crop yielding 250 cases (10,000 lbs.) per acre would remove 10.5 lbs. of nitrogen per acre from the orchard. This loss is made good by the use of fertilisers and by the micro-biological and other processes in the soil. Where nitrogenous fertilisers give no response in yield or growth it is evident that the natural soil processes and the reserves are adequate, at least for immediate purposes—nitrogen is not the limiting factor.

In America, nitrogen fertilisation has given most consistent increases in returns on older trees, on trees in a weakened conditions, and on orchards under grass or sod. Gardner, Bradford and Hooker (1922) give interesting data in Table 68, p. 206, from which the information in Table 2 is taken.

TABLE 2.

Yield of fruit and leaf weight in an apple orchard under different systems of management and the relation to the nitrates in the soil.

Treatment.	Nitrates p.p.m. Dry Soil.	Yield of Fruit per cent.	Fresh Leaf Weight per cent.
Sod	3·18	100	100
Cultivation odd years	...	132	111
Clean culture	17·40	213	123
Cultivation and cover crop	33·91	216	123
Cultivation, cover crops and complete fertilisation	...	191	135

Where cultivation enabled the soil to yield plant food as shown by the increase of nitrates in the soil, complete fertilisation in addition to cultivation effected no benefit—except in vegetative growth. Excessive increase in vegetative growth may be detrimental to the yield of fruit, particularly in dry seasons.

There are many cases recorded, principally of weak trees, in which nitrogenous fertilisers (sodium nitrate) applied in the spring have greatly increased the setting of the fruit and the yield, and have greatly increased the size of the fruit. (Information from Gardner, Bradford and Hooker (1922), p. 208, Table 69, p. 209, Table 70, p. 210.)

TABLE 3.

Effect of nitrogenous fertilisers on apple trees in weak condition.

Treatment.	Reference.	No. of Blossoming Spurs.	Percentage of Fruit Set, Sept. 30th.	Yield per Tree. (bushels.)
Check	Gardner, Bradford and Hooker	483	16·4	3·75
Sodium nitrate	Table 69, page 209	542	30·7	21·50
		Per cent. Grading.		
		175 to 150 per bushel.	138 to 112 per bushel.	100 and larger per bushel.
Check	Table 70, page 210	22·09	39·76	38·15
Sodium nitrate	... ...	2·28	26·91	70·76

Nitrogen deficiency in apples may be gauged from the symptoms given by Wallace (1933) pp. 6 and 7—

"*Nitrogen deficiency*—In pot experiments the omission of nitrogen from nutrient solutions produces deleterious effects more quickly than the omission of any other of the major essential elements, and with young trees under this treatment the growth made during the first season is frequently similar to others receiving a complete starvation diet of 'water only.' The times of opening of blossom and leaf buds are delayed, blossom formation is drastically reduced owing to the death of lateral buds, and the flowers are very weak. Foliage is relatively scanty, and after a season or two of the treatment the trees usually only carry foliage at the tips of the shoots, thus presenting a characteristic 'bare-wood' appearance. The leaves are relatively small and yellowish green in colour and often develop orange or reddish tints towards the end of the season. Small reddish brown spots may appear on the leaves. Shoot growth is drastically reduced, and after a short period of treatment the trees fail to make appreciable shoot growth. Defoliation is premature and the tints at defoliation time are reddish yellow. The barks become pale brown in colour. Fruiting is quickly reduced to a negligible amount owing to the non-development of lateral buds. Fruits are small, often highly coloured or of chlorotic appearance, relatively hard in texture, and with high sugar : nitrogen ratio. They possess excellent storage qualities both in ordinary and low temperature stores. The root systems are small in proportion to the amount of shoot growth made, and are composed mainly of fine fibrous rootlets. Nitrogen starvation is of frequent occurrence under grass systems of cultivation and is easily remedied in such cases by cultivation. Trees in low nitrogen conditions react readily to applications of nitrogenous fertilisers."

THE SUPPLY OF NITROGEN TO THE ORCHARD.

Nitrogen is supplied to the crop by means of fertilisers and by means of soil management—cover crops, legumes, etc. It seems that each orchardist must determine for himself, with the aid of expert advice coupled with field observation and experiment, the most economic and satisfactory treatments for his orchard.

(a) *By means of fertilisers.*

Nitrogenous fertilisers may be used profitably in many instances. Knowlton and Hoffman (1932) advise that early spring application, about two weeks prior to flowering, is found to be the most satisfactory time generally for readily available nitrogen. It was found that nitrate of soda equalled ammonium sulphate as a source of readily available nitrogen, but the ammonium fertilisers require the maintenance of the lime status of the soil. Nicholson and Pantin (1929) found a loss of over 50 per cent. of the nitrogen applied as ammonium sulphate, calcium cyanamide and rape dust, by drainage during the winter months, November to April.

Nitrogen, moreover, is a costly fertiliser. The cheapest form at the present time is ammonium sulphate which is quoted at £12 10s. per ton, in Perth. This is equivalent to 6½d. per lb. of nitrogen. A dressing of 3 cwts. per acre costs £1 17s. 6d., plus freight and handling expenses.

It is felt that nitrogenous fertilisers, which have to be purchased, should be used as supplements—to correct any seasonal deficiency of nitrogen not made good by the soil processes under proper management. It seems certain that, on the more fertile soils at least, the need for nitrogen can largely be met by that produced in the soil. Nitrogenous fertiliser can be used when environmental conditions are unfavourable for the natural processes to produce the quantities required by the trees. Experience shows that the most economical returns from outlay are obtained if the application of nitrogenous fertiliser is made just prior to flowering, before the soil agencies have accelerated, following the winter lag.

(b) *By means of natural soil processes.*

In the soil, processes occur whereby nitrogen gas of the air is converted into nitrogenous compounds which are useful for the growth of plants. *First,* nitrogen gas is utilised by certain soil micro-organisms in building up nitrogenous compounds in their bodies. Principal among these are the free living organisms, Azotobacter spp., Clostridium Pasteurianum, etc., which live on plant and animal residues, and the Rhizobium spp. living in the nodules on the roots of leguminous plants—peas, beans, clovers, etc. The total nitrogen content of the soil is increased by these agencies. *Second,* these organisms die and their bodies decompose, liberating ammonium compounds. *Third,* the ammonium compounds are changed to nitrates by the nitrifying organisms and in this condition are most readily available for the growth of the crop.

Depletion also occurs and nitrogenous compounds of the soil are lost by drainage, by absorption and removal in crops and by conversion into nitrogen gas. It is found that the nitrogen content of the soil is rather closely related to the amount of organic matter present, the ratio of carbon to nitrogen being approximately 10 to 1 under European and American conditions.

It is necessary, therefore, to adopt a soil management programme which will favour the maintenance of, or even increase, the content of organic matter, and hence nitrogen, and to adopt methods which will render the nitrogen available to the plant at the proper times and limit the need for the use of costly amendments.

THE SUPPLY OF ORGANIC MATTER AND NITROGEN IN THE SOIL.

In all soils there occurs a certain amount of organic matter which is the residue of the bodies of plants and animals in various states of decomposition. It is often referred to as "humus" and contains the bulk of the soil nitrogen. The ratio of

organic matter, expressed as organic carbon, to total nitrogen is relatively constant and, as mentioned above, averages about 10 parts of carbon to 1 of nitrogen. The organic fraction is of utmost importance in the soil and its quantity, similarly with nitrogen, is governed by an interaction of factors—climate, soil properties, soil management, etc. Organic matter and nitrogen are normally lower in soils under higher temperature conditions and are lower in sandy soils than in the heavier textured soils. Russell (1932) p. 364 suggests the following limits of nitrogen in English soils, under humid conditions, in relation to texture. Between these limits the values may be maintained by management—high values being obtained under grass and leguminous crops and low values when the ground is continually cultivated.

Nitrogen—Percentage in dry soil.

Limits.	Black Organic Soils—over 10 % Organic Matter (% N.).	Chalk Soils (% N.).	Clays (% N.).	Loams (% N.).	Sands (% N.).
Upper	3·0	0·42	0·35	0·25	0·20
Lower	0·25	0·13	0·09	0·09	0·03

Continual cultivation tends to lower the organic matter and nitrogen content of the soil and it is found that this loss cannot be replenished by the use of artificial nitrogenous fertilisers. Accumulation and replenishment take place under sod or pasture and depleted soils are renovated by putting under permanent pasture for a period.

As the soil organic matter is the food of many of the soil micro-organisms, which are responsible for the production of much of the available plant food in the soil, and also affects materially the soil structure, moisture relations and other properties important in plant growth, it is of utmost importance to maintain it at an adequate level. The effects of cultivation in hastening depletion must be counteracted. Of course, one of the objects of cultivation is the acceleration of the release of plant food for the benefit of the crop, and the effects of this acceleration must be met by a management programme calculated to balance the increased loss and maintain the soil organic matter at a satisfactory level.

This is accomplished—

(a) By the use of organic manures, stable manure, etc.

(b) By reversion to sod, or grazing conditions at suitable intervals.

(c) By the systematic use of green manures.

It is considered that the third method, the use of green manures, is most satisfactory for orchard practice in this State. Anthony (1925) shows that this method, particularly if legumes are used, will maintain the soil organic matter, while continuous cultivation without a cover crop leads to stunted trees.

Lipman *et al* (1928) have shown that a legume in the cover crop is necessary to maintain the level of the soil nitrogen. Other investigators support this finding. By this means the legume bacteria, Rhizobium spp., supplement the activities of the free living nitrogen fixers in the soil (Azotobacter spp., etc.) in the maintenance of the nitrogen (and organic matter) content of the soil.

Thus cover crops, including a suitable legume, are adequate to maintain the organic and nitrogen reserves of a soil under orchard conditions.

THE SUPPLY OF SOIL NITRATES.

The soil organic matter decomposes in the soil and a portion of the nitrogen is converted into the form of ammonia and nitrate, leading to a general enrichment of the soil solution and an enhanced supply of other plant requirements. Russell (1932) p. 236 summarises the situation with reference to the soil content of nitrate nitrogen as follows:—

> "Rich garden soil may contain 60 or more parts per million, arable soils 2 to 20 p.p.m., pasture soils rather less and woodland soils still less."

The fluctuations are enormous and depend on the soil, the season, the meteorological conditions and the plant cover on the soil.

In a very general way the nitrate nitrogen cycle of a soil is an index of the potential soil fertility. The accumulation of nitrate indicates that the soil is in a suitable condition for the activities leading to the formation of nitrate and in many instances these conditions are also favourable for the growth of crop plants.

Seasonal fluctuations in nitrate nitrogen content are enormous and in many instances recorded (Russell (1932) pp. 435, 436) follow the season activity of micro-organisms, being more plentiful in spring and autumn and at a minimum in winter and sometimes in summer. There is much evidence which suggests that there is generally one maximum and one minimum during the year, the maximum corresponding with spring and summer months and the minimum with the winter months. The curve reported by Russell (1932) p. 237 Fig. 29, showing seasonal variations at Rothamsted in 1915, supports these observations. The normal variability of figures for the soil content of nitrate nitrogen discussed by Prescott and Piper (1930) and observed by all workers in this field renders the observed minor maxima and minima of rather doubtful significance.

Regarding these fluctuations:—

(1) The losses of nitrate nitrogen from the soils are frequently very difficult to explain, particularly under very dry conditions such as prevail during the Australian summer. Russell (1932) p. 366, cites the experience of F. J. Martin and R. E. Massey at the Wellcome Research Laboratory, Khartoum, 1923, where first foot figures varied from 8 p.p.m. nitrate nitrogen to nil under rainless conditions and without irrigation, during the months September to March inclusive.

——	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Nitrate Nitrogen p.p.m. ...	8	2	2	1	2	Trace	*Nil*

Russell does not give the moisture contents of the soil at the various samplings, or the relation of carbon and nitrogen in the soils.

This and similar observations have not yet been explained. It is known, however, that nitrate nitrogen is lost by leaching during wet periods, by absorption by micro-organisms, by reduction to gaseous nitrogen in denitrification and by absorption by the growing crop. The effect of the growing crop (barley) on the nitrate nitrogen in soils is shown very clearly by the soil solution studies in the University of California by Stewart (1918) and by Burd and Martin (1924). In these tank experiments the nitrate nitrogen dropped from a concentration of from 50 to 150 p.p.m. of the dry soil at planting to nil or but a few p.p.m. during the period of most active growth: between 8 weeks and 16 weeks after planting. After about 16 weeks from planting the concentration of nitrate nitrogen again showed an increase, the production exceeding the utilisation. This represents the general experience reported in the literature for annual crops.

In connection with studies on an orchard soil at Davis, California, carrying peaches and pears, Proebsting (1929) found that the production of nitrate *exceeded* utilisation throughout the summer months, which is the period of *active* growth of the trees, showing that data from experiments with cereals cannot be applied to orchard conditions. The minimum nitrate nitrogen figures were obtained in April (early spring) in the check rows (winter cover crop and clean summer cultivation), the fall to the minimum and the following rise being rapid in each case.

(2) The increases in concentration of soil nitrate are also rather difficult to explain in some cases. Warm, moist conditions, where there is a favourable source of nitrogen supply in the soil, are conducive to nitrate formation and cultivation causes acceleration. The greatest accumulation normally occurs in the surface layers or in the mulch. It is suggested that the subsoil is fed with nitrates leached from the surface (Beaumont and Crooks (1933)).

The principal agencies in these fluctuations—production and consumption of nitrates—are, most probably, biological, including crop plants, bacteria, fungi, algae, etc. Recent investigations in India by Rao and Dhar (1931) and Dhar *et al* (1933) indicate the possibility of a photochemical action in the surface of the soil causing the oxidation of ammonia to nitrate; that is the action of the sunlight on the soil induces nitrate formation without the intervention of bacteria, and is an additional factor to be considered.

The losses and gains in nitrate nitrogen in the soils of the orchard described below have been brought about by the interaction of some or all of the factors mentioned. The problem is exceedingly complex, and the figures obtained for nitrate nitrogen in the soil, determined by the Devarda method, represent the amount left over after the producing factors have acted and the consuming factors —the crop, drainage, soil organisms, etc.—have taken their toll.

In cropped soils, when this figure is high and is maintained, it indicates that the soil is rich and is probably in good condition for the growth of the crop; and furthermore, production approximates utilisation. A falling figure for nitrate nitrogen indicates that the various factors causing depletion are more active than those leading to nitrate formation; when the nitrate nitrogen figure is low and remains low, it is probable that the soil is of low inherent fertility and it is possible that nitrate production is a limiting factor.

EXPERIMENTAL.

It is desirable that advisory work should be based as far as possible on local data. Where local data do not exist the experience of other places has to be used as a guide. Orchard fertilisation is but imperfectly understood, even in countries where most work has been done, and in our discussions with the Director of Agriculture on this matter, it was apparent that a programme of soil investigation would be of great value to horticultural advisers and to growers in this State. Knowledge of the nitrogen cycle in the soils of a representative apple orchard would provide the basis for a scientific programme of fertilisation and the reduction of wastage. The keen interest taken by the orchardists generally greatly facilitated and encouraged the initiation of the work, and Mr. J. Cross, of Argyle, very kindly made his orchard available for the study.

The location of the Experiment.

Argyle is an apple-growing centre in the valley of the Preston River, situated some four miles west of the town of Donnybrook and about 21 miles south-east of

the port of Bunbury. The rainfall is generous, but the bulk falls within the winter and early spring periods. The rainfall recorded at Donnybrook in points is as follows (100 points equal one inch) :—

Year.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1933	38	37	72	126	387	1,209	805	469	435	583	33	32	4,226
Average 33 years	44	65	108	175	570	783	780	601	480	305	114	66	4,091

On the average, 572 points, or 14.0 per cent., are recorded during the six months November to April inclusive, and 3,519 points, or 86.0 per cent., fall during the remaining six months of winter and early spring. The soils will be subjected to quite severe leaching during the winter months, and management must be devised to reduce the effect on the soil to a minimum.

History and Development of the Orchard and the Orchard Management.

(By G.W.W.)

Although Argyle, as stated above, is mainly an apple growing centre (that fruit comprising the major portion of the quantity produced) the district is situated in one of those favoured sports where climatic and soil conditions enable apples, pears, stone and citrus fruits to be grown successfully.

In this connection it is interesting to note the work done by the early pioneers of the industry, who, without any precedent to guide them, took up the task of finding out by actual trial what kinds of fruits would prove most profitable to grow. One of these, Mr. Stanley Parke, who came to Western Australia from Victoria in 1899 and took up land near Donnybrook for the purpose of fruit-growing, planted out a number of different kinds including red and white currants, English gooseberries, English plums, apples, pears, cherries, oranges, etc., and not only were all those fruits represented, but there were many varieties particularly of apples. Stanley Parke did his work well, and passed on, and the area under orchard on the property has since been greatly increased by his sons, but it is significant of the knowledge gained that the old portion that once was a trial ground for so many kinds and varieties of fruits, now contains only commercial varieties of apples and pears.

Mr. Cross' orchard is situated near the above-mentioned place, and some of the first trees planted in 1906 by Mr. Abe Hurst (the former owner) were obtained from the late Mr. Parke. The old orchard from where the soils for testing were taken is comprised of "Dunns" apple trees (figure 7), 22 years of age, in very healthy condition, the annual terminal growth averaging from 1ft. to 1ft. 6ins. in length, and there is no question that their sustained vigour is due in large measure to the thorough husbandry practised by Mr. Cross ever since he became the proprietor of the property. He has the good fortune to possess one essential, and one valuable aid to success as an orchardist. The first is a temperament which combines energy and optimism, and the second, a helpful and cheerful wife and family.

The trees in the younger portion (figure 8) of the orchard where soil samples were taken were planted by Mr. Cross, and are now 8 years old. They comprise apples—"Dunns," "Granny Smith," "Delicious" and "Doherty"; peaches—"Madame Sturtridge"; and English plums—"President" and "Grand Duke." This year the

terminal growths on the apple trees ranged from 2ft. 6ins. to 4ft. in length, and that on stone fruit trees from 2ft. 6ins. to 6ft.

Mr. Cross has been, and is, a stronger believer in fertilising the soil. He has varied the quantities and kinds but the yearly application is never missed. The old orchard in some seasons has been fertilised at the rate of 8 cwt. of potato manure, and the young orchard at 4 cwt. per acre, with an additional 2 cwt. of sulphate of ammonia per acre amongst heavy cropping trees, and 1 cwt. sulphate ammonia amongst the balance.

Figure 7. "Dunns."

In recent years he has applied 2 cwt. sulphate of ammonia and 2 cwt. superphosphate per acre per annum in April, and another 3 cwt. sulphate of ammonia per acre with the spring ploughing at the end of August, and it was the doubt expressed by officers of the department as to the wisdom of applying a nitrogenous fertiliser for deciduous trees in autumn that led up to the present tests.

For the first five years after planting, the weed growth in the orchard consisted mainly of clovers, but after that period clovers gave place to Cape-weed and wild geranium.

Cultivation commences by ploughing, about the end of August, as soon as the ground is in a fit condition after the winter rains; cross ploughing is done as soon as the weeds are sufficiently rotted, and then the land is kept in good tilth with spring-tooth cultivators and harrows until the end of December.

The soils of the orchard.

The principal rocks of the area are of the granite type intersected by basic dykes. On higher levels, the rocks are overlaid by a duricrust formation of lateritic material, probably representing a fossil soil horizon, Prescott (1931), p. 71. During the course of erosion, valleys have been cut through the duricrust formation exposing the country rock. The agricultural activities are confined almost entirely to these valleys where the richer soils occur associated with the weathering of the granites, etc., and showing only some admixture of lateritic material.

Figure 8. "Granny Smith."

The soils of the orchard under investigation at Argyle are principally alluvial, and occur on a terrace 20 to 25 feet above the river level. A small area of river flat, some three or four feet above river level and subject to periodic flooding, is also being developed. Sampling was confined to two soil types on the upper terrace.

Type A is a reddish-brown very sandy loam associated with the Preston River. From the river banks and observations in a drain 12-15 feet deep, it seems that this soil is many feet deep (12 or more). The profile in the drain exhibited no marked genetic changes to the full depth but washes of rounded, waterworn pebbles in the form of pockets, were observed at various levels. The principal timbers in the virgin state were red gum (*Eucalyptus calophylla*) and jarrah (*E. marginata*).

Type B is a brown sandy loam on a yellowish sandy clay loam at a depth of about 17 inches. This soil is much shallower, granite grit and granite being en-

countered up to six feet deep in the sites investigated. Granite outcrops occasionally occur. Type B appears to be associated with two small creeks, tributaries of the Preston River, and its occurrence suggests that it is formed on an alluvial fan. One site sampled to 6½ feet deep showed brown sandy loam to 17 inches on a yellow sandy clay loam . At four feet, with the appearance of the C horizon, the texture changed to a clayey, sandy grit showing mica, quartz sand and some rounded pebbles, suggestive of water action. The vegetation on this soil type resembled that on the first.

Both soils are regarded as eminently suitable for apple production, and the returns under proper management have been satisfactory.

Chemical Properties and Mechanical Analysis.

(Examinations made in the Government Chemical Laboratory).—

(a) Content of organic carbon and total nitrogen.

Samples were examined from type A in the apple orchard and from type B in the apple orchard, in pasture and in the virgin bush adjacent. The data are expressed in Table 4.

TABLE 4.

Organic carbon and total nitrogen content of soils of the orchard. Sampled 24th January, 1933.

Type.	Depth.	Condition.	Organic Carbon.	Total Nitrogen.	C : N Ratio.	Organic Matter. C x 1·724.
	inches.		%	%		
A	0–6	Apple orchard cultivated ...	1·92	·094	20·4	3·31
	6–12		·84	·045	18·6	1·45
	12–24		·36	·028	12·9	·62
B	0–5	Virgin bush	2·45	·102	24·0	4·23
	5–17		·73	·041	17·8	1·26
	17–30		·36	·029	12·4	·62
B	0–5	Apple orchard cultivated ...	1·61	·077	20·9	2·78
	5–16		·73	·039	18·7	1·26
	16–30		·18	·028	6·4	·62
B	0–3	Pasture	1·97	·113	17·4	3·40
	3–17		·82	·036	22·8	1·41
	17–30		·56	·029	19·3	·96

The soils of this orchard are on the low side for total nitrogen and organic matter when compared with the standards suggested by Russell (1932) and with the soils of King Island (off the coast of Tasmania) studied by Stephens and Hosking (1932), where the rainfall is similar but less concentrated in the winter months. The ratio of organic carbon to nitrogen is definitely high compared with Old World standards, but approximates the ratio found at King Island. In that investigation, of 62 soils examined, 18 soils showed ratios of from 10 to 15, 19 soils showed ratios of from 15 to 20, and 10 ratios of from 20 to 25. For mallee soils in South Australia, Prescott and Piper (1932) found a mean ratio of about 15; likewise definitely high as compared with data from the Northern Hemisphere.

This means some excess of organic carbon in relation to nitrogen which would tend to depress nitrate formation, but would favour the fixation of nitrogen from the air and the enrichment of the soil with respect to total nitrogen. None of the soils can be described as good with respect to organic matter, and the orchard soil (Type B) sample analysed is definitely lower than that from the pasture or virgin country, suggesting the depletion of the soil organic matter by cultivation.

(b) *Content of phosphoric oxide* (P_2O_5), *potash* (K_2O), *and lime* (CaO):—

TABLE 5.

Content of P_2O_5, K_2O, and CaO in soil types "A" and "B" at Argyle. Soluble in conc. hydrochloric acid, expressed as per cent. dry soil. Sampled 9th January, 1934.

Site No.	Soil Type.	Treatment.	Constituents.	Analysis.			
1	A	Apple orchard 22 years old	...	Sample	1	2	3
				Depth (ins.)	0–6	6–12	12–30
			P_2O_5	Percentage	·101	·027	·033
			K_2O	do.	·075	·065	·074
			CaO	do.	·338	·281	·216
3	A	do. do. ...	...	Sample	7	8	9
				Depth (ins.)	0–6	6–12	12–30
			P_2O_5	Percentage	·115	·038	·041
			K_2O	do.	·077	·057	·114
			CaO	do.	·340	·267	·222
6	B	Virgin forest	...	Sample	16	17	18
				Depth (ins.)	0–5	5–17	17–30
			P_2O_5	Percentage	·052	·054	·061
			K_2O	do.	·071	·095	·096
			CaO	do.	·218	·139	·146
9	B	Apple orchard 8 years old	...	Sample	25	26	27
				Depth (ins.)	0–5	5–16	16–30
			P_2O_5	Percentage	·068	·082	·052
			K_2O	do.	·092	·055	·093
			CaO	do.	·252	·097	·091

The two soil types are quite distinct chemically, with respect to phosphoric oxide (P_2O_5) and lime (CaO). Type A appears lower in phosphoric oxide and richer in lime. The figures for potash are comparable in both types and are definitely on the low side, particularly where clay accumulation is observed in Type B.

An interesting observation is the high figure for phosphoric oxide (P_2O_5) in the surface soil of Type A in the old orchard. This undoubtedly reflects the effect of many years of liberal treatment with superphosphate and shows that the phosphate is not removed by leaching but remains in the surface layers where it was applied.

(c) *Mechanical analysis*:—

TABLE 6.

Mechanical analysis and reaction of soils from the orchard at Argyle. Sampled 9th January, 1934.

Soil Type	A.			A.			B.			B.		
Treatment	Apple orchard, 22 years.			Apple orchard, 22 years.			Virgin forest.			Apple orchard, 8 years.		
Soil No.	1	2	3	7	8	9	16	17	18	25	26	27
Depth (ins.)	0–6	6–12	12–30	0–6	6–12	12–30	0–5	5–17	17–30	0–5	5–16	16–30
Fraction—												
Stones and roots ...					Absent from all samples.							
Coarse sand ...	14·0	13·2	12·2	14·9	13·4	10·5	26·4	18·9	12·2	30·8	25·1	19·2
Fine sand	64·4	65·5	66·5	64·9	68·1	65·3	45·4	46·4	44·5	41·1	42·6	38·1
Silt	7·2	7·2	8·4	7·8	6·9	9·3	12·0	13·1	14·5	9·9	1·9	9·6
Clay	10·5	12·6	12·6	8·8	10·0	15·4	13·2	20·1	29·7	13·0	28·0	31·1
Loss on acid treatment	1·2	·6	·5	1·2	·5	·6	1·0	·5	·9	1·5	·8	·8
Moisture	1·4	1·2	2·0	1·3	·9	1·1	1·8	1·9	2·3	1·6	1·3	2·0
Loss on ignition ...	4·2	2·6	1·3	4·3	2·4	2·8	4·6	4·1	4·4	5·9	3·7	5·0
Reaction*, pH ...	5·23	5·66	5·76	5·04	5·80	6·03	6·30	6·30	6·05	5·34	5·34	5·56

* By quinhydrone method using 1 part of air dry soil to 2·5 parts of distilled water.

Of particular interest is the predominance of the fine sand fraction in both soil types. The ratio of fine sand to coarse sand in type A is 5.05 to 1 and in type B is 2.1 to 1. Generally in Western Australia, the coarse sand fraction seems to predominate (Simpson and Teakle (1934)).

The soil reactions are normal for a humid climate. The figures suggest that the use of sulphate of ammonia has lowered the pH value, *i.e.*, has made the soil slightly more acid, in the orchard soils. As yet the lime status seems satisfactory, but depletion by the continued use of acid forming fertilisers such as sulphate of ammonia must be watched very carefully.

Determination of the fluctuations of nitrate nitrogen in the soils.

As described above, the orchard consists of two portions—the old section on soil type A and the new section on soil type B. The trees in the old section are 22 years old and those in the new, 8 years old.

Sampling was arranged to afford data concerning the fluctuations of nitrate nitrogen in the soil—

(a) of the two sections of the apple orchard;

(b) of virgin timber land of type B adjacent to the orchard;

(c) of pasture land of type B adjacent to the orchard, under the system of farm management adopted by Mr. Cross.

Later, a small plot was dug and maintained free of weeds to obtain figures for the course of nitrate formation under fallow conditions.

Sampling was done by means of an auger using a 4-inch "Iwan" post-hole digger. Three samples representing the surface, subsurface and subsoil layers were taken from each site; four sites were examined in each section of the apple orchard and in the pasture, and three sites were sampled to represent each of the other conditions, virgin, and fallow.

The surface layer varied from 3 inches to 6 inches deep and was sampled according to the profile or layers in the soil; the subsurface layer was sampled to a depth of 12 to 17 inches according to the profile, and the subsoil was taken to a depth of 30 inches below the surface.

After thorough mixing, a portion of the sample obtained by means of the auger was taken in a mason jar containing pieces of cotton wool soaked with toluene to depress bacterial activity during transit to Perth. The use of toluene is generally recommended for the preservation of soil samples in the study of nitrate fluctuations, Whiting and Schoonover (1920) p. 49. The lids were screwed on tightly to prevent loss of moisture and toluene vapour. Each sample was treated separately.

On arrival at the laboratory, generally after a period of about 24 hours, the samples were placed in a refrigerator running between 35deg. and 40deg. F. and kept in cold storage until required for analysis. Extraction of nitrates was made with utmost expedition, using two parts of distilled water to one of soil and the amount was determined by the Devarda reduction method. It is realised that the figure obtained will include any water soluble ammonia extracted with the nitrates, but the fraction is described as *nitrate nitrogen* for the sake of simplicity. This is claimed to be physiologically as valuable as nitrate and, therefore, of equal importance in this investigation. Water soluble ammonia was estimated on certain of the samples and was found to be very small—almost within the limits of error. The figures obtained ranged from nil to about 1 p.p.m. ammonia nitrogen in the dry soil. Ammonia will be important only in the soils depleted of nitrate.

Total ammonia was estimated by the Waite Method, Prescott and Piper (1928), on certain of the samples taken on April 4, 1933, with the results given in Table 7.

TABLE 7.

Total ammonia nitrogen in soils sampled April 4, 1933, at Argyle—(p.p.m. on dry soil basis).

Type.	Site.	Depth.	Condition.	Ammonia nitrogen p.p.m.
		ins.		
A	1	0–6	Apple Orchard cultivated.	5·0
		12–24		·6
B	5	0–5	Virgin Forest	5·4
		17–30		1·0
B	8	0–5	Apple Orchard Cultivated.	4·0
		16–30		1·0
B	12	0–3	Pasture	9·1
		17–30		1·6

The total ammonia nitrogen may constitute an important portion of the mineral nitrogen in the soil and in some instances where the nitrate nitrogen, determined by the Devarda method, was low, even exceeded this fraction in amount. As the bulk of the ammonia nitrogen will be held in the colloidal material of the soil—the clay and organic matter—it is not released by simple water extraction, and only a small portion, from a trace to about 1 p.p.m. of the dry soil, is represented in the nitrate nitrogen fraction. Furthermore, unlike the nitrate nitrogen fraction, it is not lost readily by the leaching action of heavy rains. It is, however, available for nitrification—the production of nitrate—and is a very valuable fraction, physiologically, in the soil.

The relation between total ammonia nitrogen and nitrate nitrogen is illustrated in Table 8.

TABLE 8.

Relation of total ammonia nitrogen determined by the Waite method, Prescott & Piper (1928) to nitrate nitrogen determined by the Devarda method in soils sampled April 4, 1933.—(figures on dry soil basis).

Soil	Site	Depth.	Condition.	Total* ammonia nitrogen p.p.m.	Nitrate nitrogen p.p.m.	Ratio—nitrate to total ammonia nitrogen.
		(ins.)				
A	1	0–6	Apple Orchard {	5·0	37·8	7·6 : 1
		12–24		·6	·7	1·2 : 1
B	5	0–5	Virgin Forest ... ... {	5·4	4·5	0·8 : 1
		17–30		1·0	·6	0·6 : 1
B	8	0–5	Apple Orchard ... ... {	4·0	15·9	4·0 : 1
		16–30		1·0	1·0	1·0 : 1
B	12	0–3	Pasture ... ... {	9·1	4·6	0·5 : 1
		17–30		1·6	3·1	1·9 : 1

* Water soluble ammonia nitrogen will be considerably less than these figures—generally less than 1 p.p.m.

The results of the investigation into the fluctuations of the nitrate nitrogen, together with soil moisture and rainfall data, are given in Tables 9, 10, and 11 and represented graphically in figs. 1-6.

TABLE 9.

Showing average concentration of nitrate nitrogen in surface, subsurface, and subsoil layers of soils of the orchard at Argyle— expressed as p.p.m. N in dry soil.

Sampling Date.	Rainfall for Period.	Surface (0–3ins. to 0–6ins. deep).					Subsurface (to 12–17ins. deep).					Subsoil (to 30ins. deep).				
		AA ppm.	BA ppm.	BP ppm.	BF ppm.	BV ppm.	AA ppm.	BA ppm.	Bp ppm.	BF ppm.	BV ppm.	AA ppm.	BA ppm.	BP ppm.	BF ppm.	BV ppm.
1933—	ins.															
January 24th ...	0·38 (from January 1st)	79·1	19·2	23·7	...	7·0	3·2	1·6	3·2	...	1·1	1·1	0·7	2·0	...	0·2
March 4th	0·72	24·3	11·1	13·7	...	3·2	2·4	2·1	2·3	...	1·7	1·3	1·3	2·2	...	0·8
April 4th	0·37	27·8	11·7	9·2	...	3·1	3·7	2·8	4·3	...	1·2	2·4	1·1	2·4	...	0·7
May 9th	1·36	37·3	7·0	13·0	...	3·0	2·7	1·0	2·8	...	1·5	1·2	0·8	1·7	...	1·0
June 14th	12·00	2·8	1·8	5·0	...	3·6	1·7	1·3	3·8	...	1·5	14·6	3·4	6·8	...	1·0
July 11th	8·81	4·4	2·5	3·6	...	2·6	1·4	2·0	2·4	...	1·5	0·9	0·9	2·4	...	1·3
August 9th	3·71	2·0	2·2	2·6	...	5·7	1·2	3·2	5·3	...	3·7	0·9	1·2	3·9	...	2·3
September 12th ...	6·62	2·4	1·9	2·0	20·9	2·2	2·6	1·7	2·5	9·0	2·3	0·7	0·4	1·1	6·9	1·4
October 9th	4·59	7·5	4·8	4·4	22·8	3·4	3·6	3·3	3·1	19·2	1·7	2·0	1·8	3·3	17·2	1·0
November 8th ...	3·10	51·5	7·1	12·7	55·0	3·2	7·0	2·5	10·9	20·0	2·0	2·4	1·6	7·7	14·7	1·1
December 12th ...	0·55	42·2	6·4	11·0	33·3	2·3	4·0	2·3	3·8	11·3	7·3	3·1	2·6	2·1	5·9	2·4
1934—																
January 9th	0·50	61·6	16·4	24·0	27·5	3·4	6·0	2·3	2·9	10·1	2·0	1·8	1·0	1·5	5·2	1·1

AA—Soil type A, old apple orchard, 22 years old. Average of four samples. BA—Soil type B, young apple orchard 8 years old. Average of four samples. BP—Soil type B, pasture. Average of four samples. BF—Soil type B, fallow. Average of three samples. BV—Soil type B virgin forest. Average of three samples.

TABLE 10.

Amounts of nitrate nitrogen in the soil to a depth of 30 inches in relation to season, rainfall, and fertiliser applications.

(*Figures express pounds of nitrogen per acre.*)

Date of Sampling.	Rainfall for period.	Nitrogen applied as fertiliser prior to Sampling.	Amounts of nitrate nitrogen (lbs. per acre).				
			Soil type A, old apple orchard.	Soil type B, young apple orchard.	Soil type B, pasture.	Soil type B, fallow.	Soil type B, virgin forest.
1933—	inches.	lbs. per acre.	lbs. per acre.	lbs. per acre.	lbs. per acre.	lbs. per acre.	lbs. per acre.
January 24th ...	0·38 (from Jan. 1)	... ...	160·3	38·4	50·6	...	14·1
March 14th ...	0·72	... ...	57·2	30·0	34·7	...	14·1
April 4th ...	0·37	... ...	73·1	32·8	38·4	...	12·2
May 9th ...	1·36	45 lbs. on old apple orchard	83·4	16·2	33·8	...	14·1
June 14th ...	12·00	... ...	90·9	22·5	48·8	...	15·0
July 11th ...	8·81	... ...	15·9	15·0	24·4	...	15·0
August 9th ...	3·71	... ...	11·3	18·8	41·2	...	31·9
September 12th	6·62	13 lbs. on old apple orchard; 9 lbs. on young apple orchard	13·1	11·3	16·9	94·7	17·8
October 9th ...	4·59	... ...	31·9	27·2	30·9	176·2	15·0
November 8th...	3·10	69 lbs. on old apple orchard	123·8	27·2	90·9	167·8	16·9
December 12th...	0·55	... ...	104·1	29·1	38·4	117·2	40·3
January 9th ...	0·50	... ...	127·5	38·4	46·9	99·4	16·9

TABLE 11.

Showing average moisture content of surface, sub-surface and sub-soil layers of soil of the orchard at Argyle—expressed as per cent. of the dry soil.

Sampling Date.	Rainfall for period.	Surface (0–3ins. to 0–6ins. deep)					Sub-surface (to 12ins.–17ins. deep)					Sub-soil (to 30ins. deep)				
		AA	BA	BP	BF	BV	AA	BA	BP	BF	BV	AA	BA	BP	BF	BV
1933—	(inches.)	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
January 24th ...	0·38 (from Jan. 1.)	2·7	5·2	1·6	...	3·6	5·0	9·1	5·8	...	4·9	4·7	12·5	10·0	...	6·4
March 14th	0·72	4·4	6·9	3·4	...	4·4	4·5	10·9	9·4	...	5·4	5·1	12·6	11·4	...	5·7
April 4th	0·37	3·4	6·0	3·5	...	6·0	5·1	9·9	7·8	...	6·8	5·7	11·1	8·9	...	8·1
May 9th	1·36	5·3	7·6	4·3	...	7·3	5·3	11·4	9·5	...	7·1	6·2	12·6	11·9	...	8·1
June 14th	12·00	18·0	10·8	18·0	...	26·5	17·8	22·0	19·6	...	18·7	18·5	22·5	20·1	...	19·8
July 11th	8·81	18·2	21·8	19·0	...	23·0	18·0	21·9	18·5	...	20·6	20·1	22·1	19·5	...	24·1
August 9th	3·71	16·6	19·7	16·2	...	19·4	16·0	19·5	16·7	...	18·4	19·3	21·4	18·9	...	21·7
September 12th ...	6·62	16·8	19·3	16·7	17·7	21·4	17·2	19·6	17·6	17·4	20·0	20·1	22·3	19·1	18·3	22·6
October 9th	4·59	16·6	19·2	18·5	18·1	22·3	16·4	19·6	16·7	14·7	19·1	17·9	21·5	19·2	16·6	20·8
November 8th ...	3·10	13·5	16·5	8·1	8·5	12·5	14·4	17·8	12·4	13·9	16·5	14·6	20·1	16·3	15·6	18·9
December 12th ...	0·55	9·2	13·6	3·4	6·0	5·9	8·1	16·5	8·9	12·2	10·4	11·2	18·4	12·3	10·8	15·4
January 9th	0·50	4·7	8·0	3·4	5·2	5·2	4·4	11·9	9·4	12·2	5·1	7·3	15·8	12·6	13·3	8·8

AA—Soil type A, old apple orchard—22 years old. Average of four samples.
BA—Soil type B, young apple orchard—8 years old. Average of four samples.
BP—Soil type B, pasture. Average of four samples.
BF—Soil type B, fallow. Average of three samples.
BV—Soil type B, virgin forest. Average of three samples.

DISCUSSION.

The nitrate nitrogen constitutes but a small fraction of the total nitrogen in the soil. In this investigation the nitrate nitrogen ranged from 0.9 p.p.m. to 90 p.p.m., *i.e.*, from .00009 per cent. to .009 per cent. in the surface soils. The total nitrogen content of the surface soils ranged from .077 per cent. to .113 per cent., so that this water soluble portion ranged from one-tenth to one-thousandth of the total nitrogen. The total nitrogen represents the reserve from which the available and water soluble fraction is formed—and every care must be taken to maintain and protect this reserve.

This investigation proves that the orchard soils studies at Argyle, although on the low side for *total* nitrogen or reserve nitrogen, have a very considerable capacity for the production of nitrate nitrogen during the spring and summer months which is the period of active growth by the fruit trees. Furthermore, that the soils are reduced to almost complete depletion with respect to nitrate during the cold, wet winter months. This is in keeping with the results obtained elsewhere and shows that we can benefit from experience in orchard management in other parts of the world, particularly in America. The minor fluctuations in the graphs are regarded as being of little importance on account of the factor of soil variability which is particularly prominent in the nitrate fraction. Prescott and Piper (1930) have given some evidence in this connection. Evidence obtained in this investigation is no less striking as seen in Table 12.

TABLE 12.

Variations of nitrate nitrogen content of samples from surface soils—Argyle.

Month	Site	Old apple orchard, type A—0–6ins. p.p.m. N.	Pasture, type B Surface soil p.p.m. N.
January	1	85	13·6
	2	71	13·1
	3	95	55
	4	65	13·1
April	1	38	4·5
	2	28	12·9
	3	16	13·1
	4	30	6·1
June	1	1·8	2·7
	2	1·7	12·9
	3	1·5	2·0
	4	6·2	2·0

In nitrate nitrogen studies, replicate samples must be taken and the significance of small differences discounted. Some investigators claim that the soil should be sampled to a depth of 2 to 3 feet at weekly intervals to obtain reliable data. While this sampling was done only at monthly intervals, it is apparent that a study of the curves and data will afford the basis for a logical use of nitrogenous fertiliser and the obtaining of higher efficiency in orchard management.

A study of the fluctuations observed in this investigation suggests that there is a minimum concentration of nitrate nitrogen in the soil, below which figures are seldom obtained. This appears to be in the neighbourhood of 1 to 1.5 parts per million of "nitrate" nitrogen in the dry soil, considered to a depth of 30 inches and, at this concentration, the fraction will often contain a considerable proportion of water soluble ammonia. The virgin forest soil appears to remain at or near this

minimum throughout the season and the soils of the apple orchard attain it only during the period of winter dormancy and leaching and in the early spring when the trees and cover crop make their heaviest demands on the soil. As regards *quantity* of "nitrate" nitrogen in the soil, this minimum amounts to from 10 to 15 lbs. of nitrogen per acre 30 inches deep, which is equivalent to from 50 to 75 lbs. of sulphate of ammonia per acre. It is felt that this minimum should always be exceeded in a cropped soil during the period of active growth. The figures obtained from the young orchard during October, November and December, when the trees were making very vigorous growth, suggest that, if the soil is maintained at a minimum of 3 parts per million of nitrate nitrogen in the soil, or about 30 lbs. of nitrate nitrogen (equivalent to about 140 lbs. of sulphate of ammonia) per acre 30 inches, the trees will make vigorous growth. Whether a higher level, as maintained in the old orchard, largely by the addition of sulphate of ammonia fertiliser, is beneficial to the growth and yield of the trees, cannot at present be decided. It is felt that there is a distinct limit to the economic level at which the nitrate nitrogen concentration in the soil can be maintained.

Nitrogenous fertiliser augments the water soluble nitrogen fraction and may be detected by analysis. It would seem futile and wasteful, therefore, to use nitrogenous fertiliser when the soil is rich in nitrate or when it is certain to be lost in the drainage water. Furthermore, ammonium salts generally depress the growth of clovers and leguminous plants and do not promote the organic matter accumulation in the soil "humus" or offset the destructive effects of clean, summer cultivation on the soil organic matter. Orchard management must be directed to a very vigorous green manuring programme and the green manure crop must include a vigorous legume. Autumn fertilisation with superphosphate and, perhaps, potash is advised to promote the growth of the cover crop. Nitrogen fertiliser at the commencement of the rainy season will give a temporary stimulation particularly to the non-leguminous plants, but will soon be lost in the drainage system. Nitrogen is, therefore, best applied in early spring.

It seems unlikely that any attempt to maintain a high content of nitrate nitrogen in the soil throughout the winter months will be either desirable or practicable. Little is known concerning the root activities of fruit trees during dormancy, but it is unlikely that there is need for large supplies of nitrogen in the soil at that time.

Where ammonium compounds are used as fertilisers, care must be taken to maintain the lime status of the soil. Nitrogenous fertilisers in this State are generally in the form of sulphate of ammonia. Presuming that all of the nitrogen is absorbed by the plant, sulphuric acid is the residue from the use of this fertiliser. Every hundredweight of commercial sulphate of ammonia contains the equivalent of 81 pounds of sulphuric acid, capable of dissolving 46 pounds of lime (CaO). While there seems no immediate danger on the Argyle soils studied, sulphate of ammonia must always be used with care on account of its action on the acidity and lime reserves of the soil.

It is encouraging that these soils exhibit considerable powers of nitrate formation. This reflects the fertility of the soils, as there is a general correlation between nitrate production and crop production. The figures for phosphoric oxide in the old orchard indicate that the superphosphate applications over a period of 22 years have led to enrichment of the surface soils with respect to phosphate. A high level of fertility is being induced by the system of management employed.

Spring and summer cultivation relieve the trees of competition with weeds, aerate the soil, improve the tilth, and promote plant food formation for the benefit of the crop. It leads to a heavier drain on the capital reserves of the soil, particularly with respect to organic matter and nitrogen, and management must

be arranged to counteract this depletion. Mineral manures alone are inadequate, but used in conjunction with cover crops, which must include a vigorous leguminous plant, the organic matter and nitrogen fractions can be maintained even with the practice of clean summer cultivation. American experience shows that clean cultivation, without organic manures or cover crops in season, lead to soil depletion, stunted trees and reduced crops.

The question of nitrogen fertilisation in the autumn receives light from this investigation. There is a general falling-off in nitrate concentration of the soils during the autumn. This cannot be ascribed to any one factor and is certainly not due to leaching as no soaking rains were recorded. In spite of this falling-off, there seems sufficient present, however, to meet the needs of the orchard prior to the winter rains and dormancy. The fate of the 2 hundredweight of sulphate of ammonia applied to the old apple orchard toward the end of April demonstrates the economic loss of using a soluble nitrogenous fertiliser at this time. A temporary rise in water soluble nitrogen followed this application and was detected in the surface in May. In June, there was no evidence of the added nitrogen in the surface and subsurface layers but it showed very distinctly in the subsoil (see Fig. 2 and Table 9). With the continuance of the winter rains it disappeared from the subsoil which was reduced to a very low level of concentration (0.9 p.p.m. N) by the time of the July sampling. It is considered that much greater benefit would have accrued from the application of this fertiliser at the time of the August ploughing.

The results show a reciprocal relationship between the soil moisture content and the concentration of nitrate nitrogen.

SUMMARY AND CONCLUSIONS.

A general review of the question of nitrogen fertilisation and management is given and mention is made of the new method of attack on the problem of tree culture.

The biological factors in the soil and their role in the production of nitrate are discussed.

An investigation is described in which two soil types, Type A and Type B, of a well managed apple orchard at Argyle, near Donnybrook, Western Australia, were sampled at approximately monthly intervals. Soil type A is a deep river alluvium of a light sandy loam texture showing practically no change in the profile. The orchard on this type is 22 years old and very well grown. Soil type B represents a shallower soil formed on an alluvial fan adjacent to the river alluvium. It has been under apples for a period of 8 years only but is proving very satisfactory, the trees being very vigorous and well grown. The water soluble nitrogen fraction was extracted and analysed by the Devarda reduction method. Generally, this fraction will consist principally of nitrate nitrogen and is referred to as nitrate nitrogen in the tables and figures although it is realised that the water soluble fraction usually contains a small amount of ammonia nitrogen. Certain samples were further examined for total nitrogen, phosphoric oxide (P_2O_5), potash (K_2O), lime (CaO), organic carbon, reaction (pH) and mechanical analysis.

For purposes of comparison soil type B under virgin conditions, under pasture and under fallow, was studied along parallel lines.

The results show that—

1. Soil type A and soil type B are distinct soils chemically and mechanically. They represent good apple soils which are being maintained in a satisfactory state of fertility.

2. Large dressings of superphosphate during 22 years' management under apple orchard conditions have resulted in a substantial accumulation of phosphate in the surface soil.

3. The nitrate nitrogen accumulates in the orchard and pasture soils during the spring and summer. The amount falls off during the autumn and reaches a low minimum during the cold, wet winter months.

4. The soil of the apple orchard, type A, shows a much larger accumulation of nitrate nitrogen during the spring and summer months than does type B in the young orchard. This is in spite of the heavier demands of the larger, heavier yielding trees, and indicates the soil to be at a higher fertility level at present. This may be the result of a longer period of careful orchard management.

5. Deducting the nitrogenous fertiliser application in the spring, the soil of the old apple orchard, type A, to a depth of 30 inches contained 32, 55, 35 and 59 lbs. of nitrate nitrogen for the months of October, November, December, 1933, and January, 1934, respectively. Similarly, the soils of the young orchard, type B, contained 27, 27, 29 and 38 pounds of nitrate nitrogen respectively for the same periods. These figures represent the residual nitrogen after the demands of the crops have been met. From these data it is postulated that a soil maintained at about 30 pounds of nitrate nitrogen per acre 30 inches deep will be able to supply the needs of the apple trees for nitrogen. This is equivalent to about 140 pounds of sulphate of ammonia per acre and represents a concentration of a little over 3 parts per million of nitrate nitrogen on the dry soil basis.

6. The use of large quantities of sulphate of ammonia when the soil is already well supplied with available nitrogen seems economically wasteful. Early spring, when the soil processes are still slow, is the best time to apply nitrogenous fertilisers.

7. Autumn applications of sulphate of ammonia are likely to depress the growth of legumes in the cover crop and a considerable proportion is certain to be lost by leaching with the incidence of the heavy winter rains. Autumn applications cannot be recommended.

8. These soils are on the low side with respect to total nitrogen and contain only medium amounts of organic matter. No effort should be spared to maintain and even improve the total nitrogen and organic matter status of these soils as destruction is very rapid under the system of clean, summer cultivation. It is suggested that cover crops including a vigorous legume should be grown each year.

9. The soils under pasture were subject to less marked fluctuations than those under orchard treatment. Generally, there was slightly more nitrate nitrogen in the soil of the same type under pasture than in the orchard.

10. The fallowed soil was richer in nitrate nitrogen than the pasture or orchard soils. The fluctuations observed are difficult to explain at present.

11. In the virgin forest a minimum concentration of nitrate nitrogen was recorded throughout the year. Apparently the virgin forest with its undergrowth had adapted itself to absorb practically all of the available nitrogen and maintains a minimum concentration in the soil.

ACKNOWLEDGMENTS.

The authors desire to acknowledge the assistance of the Director of Agriculture in the organisation of this investigation; of Mr. D. Breen who assisted in the sampling; of colleagues who assisted in the chemical work; and of the Chief Draughtsman of the Lands Department who undertook the preparation of the figures.

We desire particularly to thank Mr. J. Cross, of Argyle, who made his orchard available for this study and also assisted in the taking of the samples.

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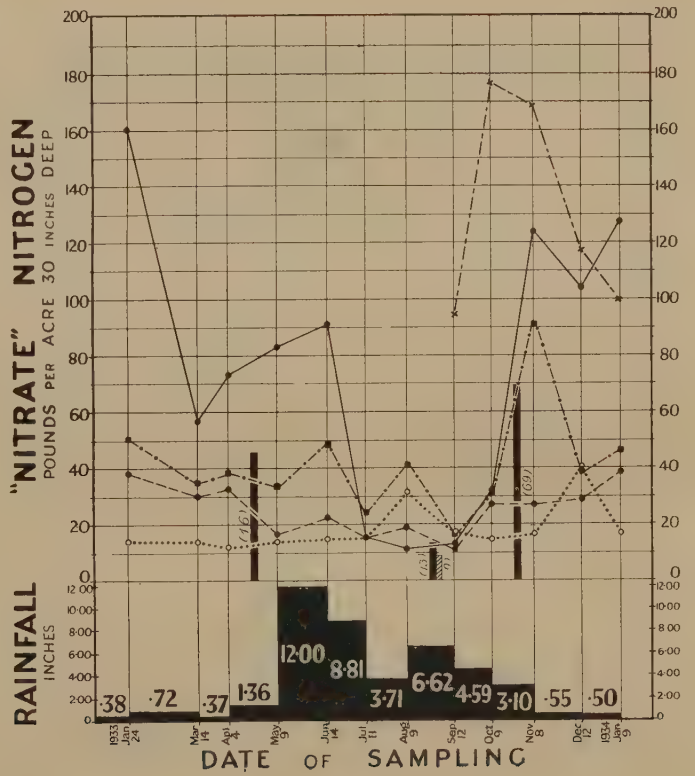

FIGURE 1

Showing distribution of the RAINFALL and AMOUNTS of "NITRATE" NITROGEN (principally Nitrate and Ammonia) in two types of SOIL at ARGYLE
(a) in the APPLE ORCHARD
(b) under PASTURE
(c) under FALLOW
(d) in the VIRGIN FOREST
expressed as POUNDS of NITROGEN per ACRE of SOIL 30 inches deep for the Season – January 1933 to January 1934.

LEGEND

SOIL TYPE A
APPLE ORCHARD
SOIL TYPE B
APPLE ORCHARD
PASTURE
FALLOW
VIRGIN FOREST

NITROGEN x 4·7 = SULPHATE of AMMONIA (PURE)

NITROGEN applied as SULPHATE of AMMONIA FERTILISER to the APPLE ORCHARD TYPE A ▮ TYPE B ▨

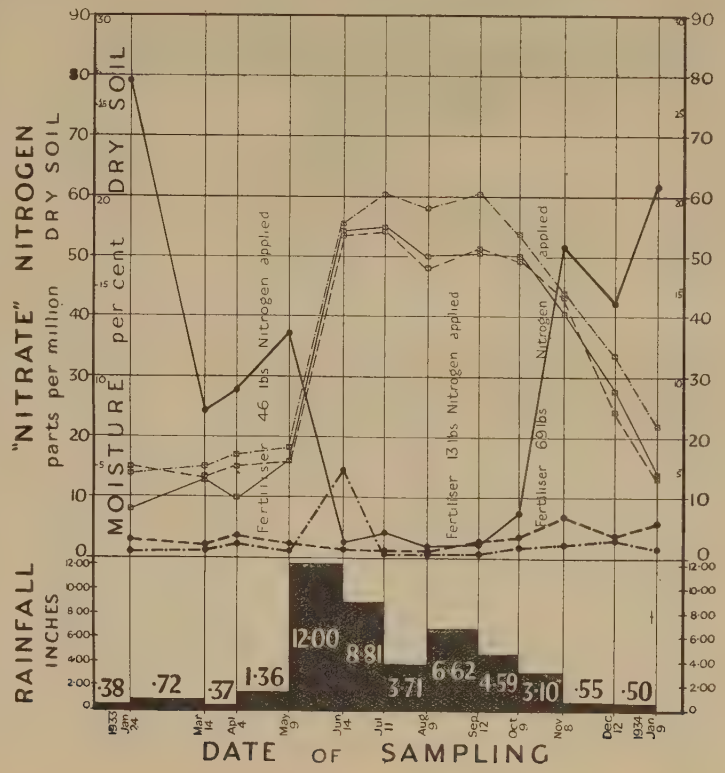

FIGURE 2

TYPE A APPLE ORCHARD

Showing seasonal fluctuations of "NITRATE" NITROGEN (principally nitrate with a little ammonia) and SOIL MOISTURE in the SURFACE, SUBSURFACE and SUBSOIL layers in relation to RAINFALL at ARGYLE January 1933 to January 1934

LEGEND

"Nitrate" Nitrogen
- Surface
- Subsurface
- Subsoil

Soil Moisture
- Surface
- Subsurface
- Subsoil

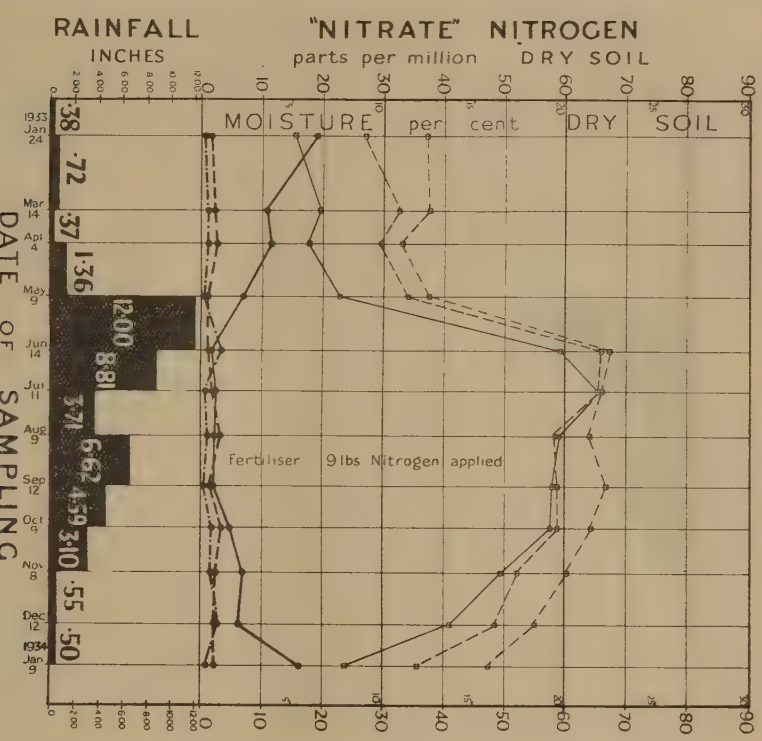

FIGURE 3

TYPE B APPLE ORCHARD

Showing seasonal fluctuations of "NITRATE" NITROGEN (principally nitrate with a little ammonia) and SOIL MOISTURE in the SURFACE, SUBSURFACE and SUBSOIL layers in relation to RAINFALL at ARGYLE January 1933 to January 1934

LEGEND

"Nitrate" Nitrogen
Surface
Subsurface
Subsoil

Soil Moisture
Surface
Subsurface
Subsoil

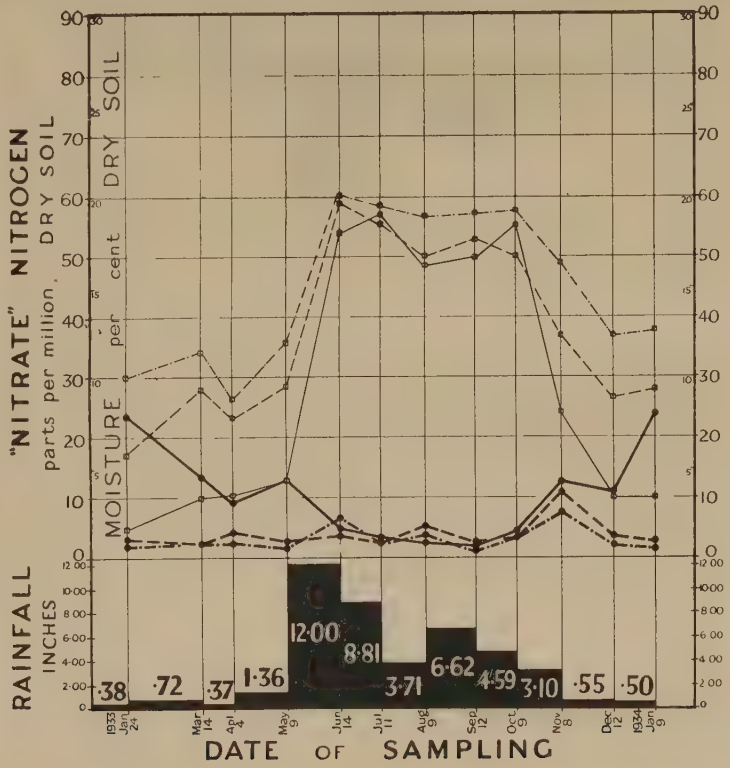

FIGURE 4

TYPE B PASTURE

Showing seasonal fluctuations of **"NITRATE" NITROGEN** (principally nitrate with a little ammonia) and **SOIL MOISTURE** in the **SURFACE, SUBSURFACE** and **SUBSOIL** layers in relation to **RAINFALL** at **ARGYLE** January 1933 to January 1934

LEGEND

"Nitrate" Nitrogen

- Surface
- Subsurface
- Subsoil

Soil Moisture

- Surface
- Subsurface
- Subsoil

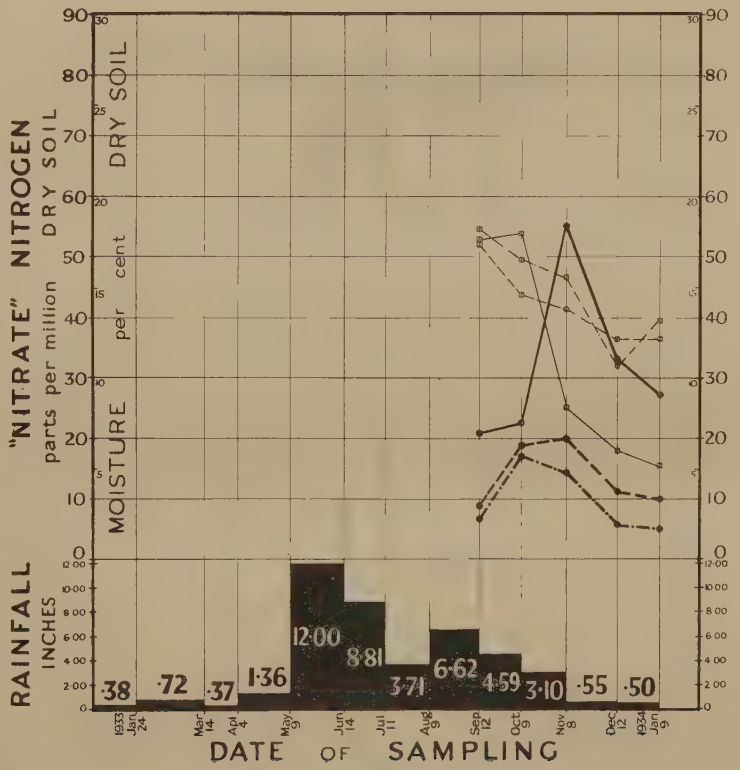

FIGURE 5

TYPE B FALLOW

Showing seasonal fluctuations of **"NITRATE" NITROGEN** (principally nitrate with a little ammonia) and **SOIL MOISTURE** in the **SURFACE, SUBSURFACE** and **SUBSOIL** layers in relation to **RAINFALL** at **ARGYLE** January 1933 to January 1934

LEGEND

"Nitrate" Nitrogen
- Surface
- Subsurface
- Subsoil

Soil Moisture
- Surface
- Subsurface
- Subsoil

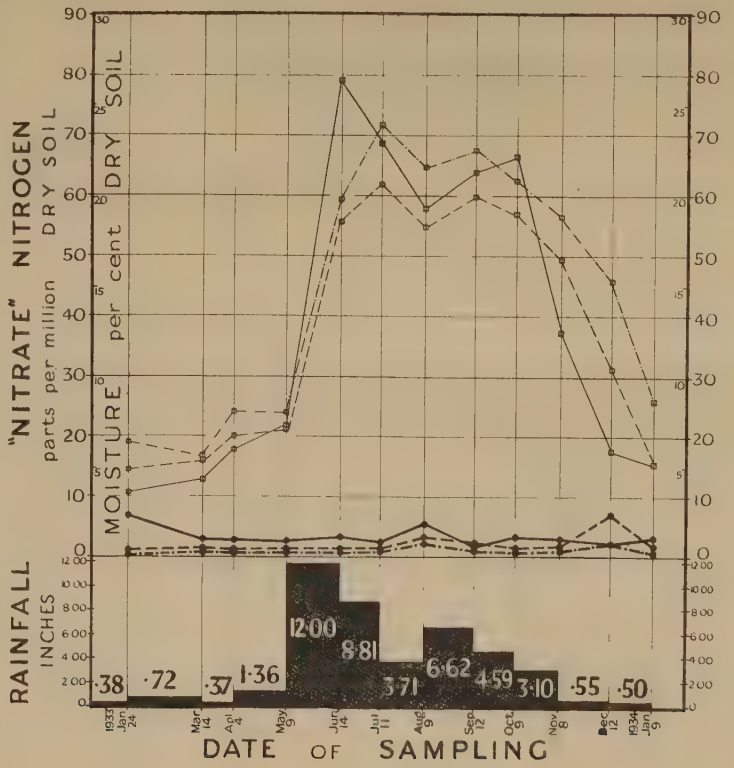

FIGURE 6

TYPE B VIRGIN FOREST

Showing seasonal fluctuations of "NITRATE" NITROGEN (principally nitrate with a little ammonia) and SOIL MOISTURE in the SURFACE, SUBSURFACE and SUBSOIL layers in relation to RAINFALL at ARGYLE January 1933 to January 1934

LEGEND

"Nitrate" Nitrogen
- Surface
- Subsurface
- Subsoil

Soil Moisture
- Surface
- Subsurface
- Subsoil

ENTOMOLOGICAL PROBLEMS.

THE INTRODUCTION, INCREASE AND CONTROL OF VARIOUS INSECT PESTS.

L. J. Newman, F.R.E.S.,
Entomologist, Department of Agriculture.

Prior to the year 1890, when the gold rush to Western Australia took place, but slight attention had been given to the agricultural and horticultural possibilities of this State. With the great increase of population which followed the discovery of gold, new towns came into existence. This created a demand for foodstuffs, far beyond the powers of production of the then agriculturists and suggested the possibility of utilising the State's lands to a greater extent. It was soon proved that most of the produce required could be grown within the State, and with this awakening, there arose the need for guidance in the protection of crops against the numerous insect pests.

The country in its original state, did not carry plants and animals suited to the requirements of the white man, which meant that almost everything required for our race had to be introduced. With these early introductions, many serious pests of plants and animals were unfortunately brought to our shores and became established pests. We cannot blame our forbears, as they were struggling against great odds and ignorant of the noxious nature of many of the insects, plants and animals they introduced. One cannot help, however, regretting the great opportunity of preventing the introduction of these pests that was then lost. If the rigid quarantine, associated with modern administration, had then been operative, we would now be enjoying a wonderful degree of freedom from a large number of the pests that take such a heavy annual toll of our produce. The activities of injurious insects, which furnish the problems of applied entomology, are always more pronounced in countries where, for various reasons, the stability of the physical or biological environment is changed.

One of the chief causes affecting the stability of the environment, and consequently the activities of the insects introduced in such countries as Western Australia, is the extension and development of large agricultural and pastoral areas. This not only modifies the natural environmental conditions of native insects, but the replacement of the natural flora by introduced plants has placed the insects, fortuitously brought in from other lands, in new surroundings.

In many instances the destructive insects so introduced have established themselves under conditions of climate more suited to their rapid development than in the country of their origin, and minus their natural enemies. Under such conditions there is always the possibility of an insect becoming a very serious pest. Any disturbance of the "balance of nature" always brings its penalties. As an instance of the various species of aphids found infesting our gardens, not one is native to Australia, and it is now realised that the control of aphids constitutes a very serious problem. The same may be said of the scales infesting orchards and gardens; there is no instance of a native scale seriously attacking fruit trees or garden plants. This affords the answer to a question so often asked as to why entomologists are faced with more problems in newer agricultural and horticultural countries than in older settled countries. To mitigate the great damage that can be caused by insects, the farmer, orchardist and pastoralist are dependent upon expert advice. This demand led to the formation of the Bureau of Agriculture in 1894, and in the year 1899 it was advanced to the status of a Department.

FRUIT FLY

(*Ceratitis capitata*).

The first problem which called for special research was the Fruit Fly. This serious pest was introduced some forty years ago from Southern Europe, per medium of imported citrus fruits, before sufficient citrus fruits for our local requirements were being produced.

The pest was first recorded in Guildford, but, unfortunately, there was no entomologist to advise upon the nature of the insect or the action to take for its eradication or control. Consequently, the pest soon became widespread around Perth. Had its potential powers as a fruit destroying insect then been recognised, it could have been eradicated, but to-day it is permanently established in our West Coastal plains, and spreads each summer into many of the Darling Range orchards. It is a most insidious and difficult pest to deal with.

The first efforts towards control were made along biological lines. Mr. Compere, Entomologist to the Department at that time, was commissioned to search various parts of the world for natural enemies, and parasites of various other related species of fruit flies were obtained and forwarded to this State. It was the duty of the writer to breed up these parasites, destroying all secondaries and liberating only the primaries in the orchards. Myriads of parasites were thus reared and distributed. Unfortunately, up to date negative results have to be recorded, and no effective natural control of the Mediterranean Fruit Fly has yet been discovered.

In passing, it is worthy of note that Western Australia was the first State in the Commonwealth to undertake or attempt biological control of insects.

The life history of this fly was worked out as it occurs in Western Australia, proving that there is a complete generation every 34 days from mid-October to mid-April, and that the main carry-over during the winter (May to September) is per medium of over-wintering flies.

The discovery that the male fly exhibited a peculiar chemotropic reaction to kerosene, when used as a lure, encouraged continued research along these lines. It was then discovered that pollard and water was very attractive to the female fruit fly, and this resulted in the issue of the pollard, bran and water formula, which is still recommended by the Department of Agriculture. Work was continued, and more recently Clensel, a proprietary liquid soap, has been found a very excellent lure. A fruit juice poison bait was also evolved.

Full particulars in regard to the methods of poisoning or luring the fruit fly can be obtained from the Department of Agriculture. It must be remembered that the successful control of this pest can only be accomplished by the active co-operation of all concerned.

BLACK SCALE

(*Saissetia oleae*).

The Black Scale was at one time one of the most destructive scale insects. It attacked citrus and many deciduous fruit trees and numerous garden plants. Biological control of this pest was undertaken with very positive results, as several body and egg parasites were successfully introduced from various parts of the world. Some of these parasites are now well established and have resulted in the restoration of the balance of nature. To-day this scale is, generally speaking, of little consequence in Western Australia. In work of this nature, great care has to be exercised to prevent the introduction of secondary parasites, as any mistake in this regard would permanently nullify the effectiveness of the primary parasite.

CABBAGE APHIS AND CABBAGE MOTH

(*Aphis brassicae and Plutella cruciferarum*).

These two insects (the former a sap sucker, the latter a chewing insect), at one time rendered it almost impossible to successfully grow payable crops of cabbage, cauliflower or turnips. To-day the position is greatly improved by the introduction of parasites from the Orient, which help in a great measure to keep down these pests. Artificial methods have also been advised. Owing to the dry weather experienced during the summer months, which favours the increase of the Cabbage Moth caterpillar, considerable damage is sometimes experienced in the autumn crop, but if the crop is kept growing vigorously and the recommended remedial measures applied, the difficulty can be overcome.

THE MEALY BUG

(*Detylopius sp.*).

The above ground form of the Mealy Bug, in citrus orchards, was at one time a very destructive pest. It has been brought below the danger line by the successful introduction of the Queensland Ladybird (*Cryptolaemus montrouzieri*).

PLAGUE LOCUST

(*Chortoicetes terminifera*).

This is one of the few native insects which were very troublesome in the early stages of wheat farming in North-Eastern and Eastern wheat areas.

The trouble was brought about by the clearing of the natural forest belts in preparing the land for wheat growing. The timber belts acted as natural barriers, which kept the locusts more or less localised. A careful life history study of the locust was made and it was found that the eggs were laid in October-November into bare hard land, such as stubble, non-grassy country, roadsides, etc. These eggs hatched in July into tiny hoppers, which reached the adult winged stage in six to eight weeks. Methods of control were tested and it was demonstrated that the plague locust could be prevented by the systematic shallow ploughing of all areas where the eggs have been laid, as the eggs are thus exposed to the elements and predatory enemies. Where this can not be successfully done, the use of a poisoned bran bait, applied to the hoppers, is found to be very effective.

By the adoption of these measures co-operatively, the locust can be controlled. The danger now facing the farming community arises from abandoned farms: in these unattended areas the locusts are again breeding up, and sooner or later will reach plague form and cause great economic losses.

THE ARMY-WORM AND WEB-WORM

(*Persectania ewingii* and *Sclerobia tritialis*).

These, like the locusts, caused a good deal of loss in the initial stages of farming, but it has been proved that by good farming methods, such as clean fallow, early ploughing and poison baiting, that the caterpillars of both these moths can be successfully combated. Late sowing in weedy or grassy land, or on stubble, is courting trouble from these insects.

BLOW-FLIES—VARIOUS.

There is no doubt that the blowfly problem amongst sheep is one of the most serious insect problems.

In spite of all efforts such as crutching, dipping and jetting, very great numbers of sheep are annually lost to the State through attack by one or other of the primary blowflies.

In an effort to obtain knowledge regarding the seasonal and regional distribution of the blowflies and the species responsible for the damage, a trapping survey of the South-West was made, which revealed the presence of four primary blowflies. The discovery of the fourth species is the result of recent research. This is the Bluebottle fly known as *Lucilia cuprina*, the most active primary blowfly of the Eastern States.

Every effort to control blowflies by biological means has been made. Several species of parasites have been introduced from other countries and distributed in large numbers, but the testing of this method has forced the conclusion that there is little hope of success along biological lines.

In further studying this problem we have evolved a blowfly trap, commonly known as the West Australian blowfly trap, which has been tested against all other types of traps and has proved the most effective. Trapping methods are being officially tested both in this and the Eastern States, but results have not yet been finalised. Considerable testing with fly repellents has been done, but so far no specific used on sheep has given any lengthy period of immunity from fly strike. It is now considered that much of the trouble from blowfly strike of sheep is due to the breeding of susceptible types, and that to overcome this the susceptible sheep, those that are badly wrinkled about the breech, will have to be eliminated from our flocks.

THE LUCERNE FLEA

or, as it is now being called,

THE CLOVER SPRINGTAIL

(*Sminthuris viridis*).

This was first discovered in the State in 1915 following the drought year of 1914, during which year large quantities of lucerne hay were imported from South Australia. The Clover Springtail has been known in that State for over forty years and it is therefore thought that it was per medium of this hay that the pest was introduced to this State. The flea rapidly spread and is now found established in almost every part of the South-West having a rainfall of 16 inches or over Fortunately it is confined to the soils of a colloidal nature and which have a surface of decomposed organic matter, with good moisture-holding capacity; it is never found on sandy light dry lands. It is purely a wet season insect, making its appearance 10 to 12 days after the first general autumn rains, the young issuing from aestivating or over-summering eggs laid in the late spring. These eggs, which are laid on the surface of the ground in cracks and crevices in the soil, withstand the heat and dryness of the summer, remaining practically dormant for six months.

It is most unfortunate that coinciding with the spread of subterranean clover this pest was introduced. The insect has taken advantage of the feast spread for it in the shape of subterranean clover.

Experimental work to destroy the Springtails per medium of poison dusts and sprays was carried out, but there were many negative results. The outstanding success was from the use of a lime-sulphur spray at a strength of 1 part of the mixture to 60 parts of water—a spray which destroys both by contact and ingestion. It is non-poisonous, and cattle readily feed over pasture thus treated.

Unfortunately, as the pest is so widespread, the use over large areas of any artificial treatment is not economically possible, but in small areas such as lucerne plots, etc., control can be had by the use of the lime-sulphur spray.

Early spring fallowing will destroy the pest before the over-summering eggs have been laid, and autumn ploughing after the eggs have hatched is also an effectual check. Slow-burning fires will destroy large numbers of eggs. Agrostological work is now being done with the object of selecting strains of clover and other suitable fodder grasses unpalatable to the flea.

During research work in the field, a parasite mite, commonly known as the Bdellid Mite, was discovered. This mite is of European origin, as is the Clover Springtail, and there are grounds for believing that this predator will prove a definite controlling factor. The collection and distribution of this mite is being undertaken. It has now been successfully colonised in several areas, and it is intended to continue the work of distribution. Unfortunately, it cannot be bred up in cages, hence it has to be collected in the field, which is slow work. Colonies have also been forwarded to South Australia, Victoria and Tasmania.

THE RED-LEGGED EARTH MITE.

This is undoubtedly the most difficult of all our pasture problems. It is not a true insect, being one of the non-webspinning mites.

Like the Clover Springtail, it is a wet-season pest, also producing an over-summering egg which carries over the dry season from spring to autumn. It is more widespread than the Springtail, being found inhabiting all types of soils and extending its range to the extremes of the wheat belt and thriving in as low a rainfall as 10 inches. First recorded in this State from Bunbury district in 1920, it is also found in all the Eastern States, except Queensland. Its food habits are more cosmopolitan than the Clover Springtail, but like this insect it is very partial to clovers and other legumes.

The cultural methods, as employed against the Springtail, are effective. In small areas it can be controlled by the use of sprays or dusts having a carbolic content, and dusting with naphthalene is also effective. Considerable search has been made both here and in other parts of the world for controlling parasites, but so far with negative results. Agrostological research is also being employed to find mite-resisting fodder plants and grasses.

THE APPLE WOOLLY APHIS.

For some time this was a most serious pest of apple trees until in 1925 the successful introduction and establishment of a very effective internal parasite of this aphid, *Aphelinu smali*, was effected. In connection with this pest a tribute should be paid to the late Mr. W. Grasby for his great interest and kindness in permitting the use of his garden, under quarantine, for the purpose of establishing this beneficial wasp. To-day the spray pump in most instances is not required for the control of Woolly Aphis, the parasite doing the control free of cost to the growers.

CODLIN MOTH

(*Cydia pomonella*).

It is pleasing to be able to state that, although there have been eleven outbreaks of this very serious pip-fruit pest, the State to-day is clean. This happy result, which means so much to the apple and pear export business, has been brought about by the hearty co-operation of fruit growers with the Department of Agriculture.

GREEN TOMATO BUG

(*Nezara viridula*).

This is a pest of more recent introduction and is very difficult to control. Being a sap-sucking insect, it can only be controlled by contact spraying and complete

farm sanitation. Efforts have been made to introduce various parasites which are known to exist in Florida and Egypt. An account of this work is given in leaflet No. 179.

BUFFALO FLY

(*Lyperosia exigua*).

The Buffalo Fly is a small blood-sucking fly. Every reasonable effort is being made to confine this pest to those areas in the North-West where it has become established. Parasites from Java have been introduced by the Federal Entomological Department, and it is hoped these will become established and prove a natural check.

THRIPS

(*Thrips imaginis*).

During recent years a native flower thrip has assumed the role of a very serious apple and pear pest, although its depredations are by no means confined to these fruits, many kinds of garden flowers being also seriously attacked. This pest is at present the subject of investigations both here and in the Eastern States. Two entomologists and a chemist are working at the problem under Dr. Davidson, Entomologist, at the Waite Institute, Adelaide.

When this pest appears in plague form at the time of apple blossoming it ruins the bloom, resulting in a non-setting of fruits. Fortunately, this does not happen every year.

There is, however, a potential plague every year should the blooming of the apples synchronise with a rise in the soil temperature, due to a spell of early warm weather.

The chief native host plant of this thrip is found to be the common yellow prickly Mimosa. Every effort is being made to discover, if possible, some effective repellent spray that can be applied as the flower buds begin to show colour; there are no known effective parasites of this insect.

Thrips are very soft-bodied insects and in gardens can be checked by the use of contact sprays.

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ROYAL AGRICULTURAL SOCIETY.

SUMMER FODDER CROP COMPETITION.

H. G. Elliott,
Agricultural Adviser, Dairy Branch.

The Summer Fodder Crop Competition was continued during the season 1934, being conducted by the Royal Agricultural Society.

Judging was carried out by W. Ireland, Dairy Supervisor, Manjimup, and H. G. Elliott, Agricultural Adviser, Dairy Branch.

Owing to the continued dry season, the summer fodder crops outside the irrigation areas were generally poor, but the results obtained by competitors show the value of thorough cultivation.

The accompanying illustration shows a portion of a one-acre stand of marrow-stemmed kale grown by Mr. Candy, of Forrest Hill, Mt. Barker. This crop was estimated to yield in the vicinity of 30 tons of green material per acre.

The particulars of the points gained, and the methods of cultivation adopted by the competitors, are shown in the following tables:—

Competitor.	Yield 50	Evenness of Growth 10	Freedom from Weeds 15	Cultivation 15	Freedom from Disease 10	Total. 100
H. Brown, Manjimup.	47	9	11	12	10	89
C. Candy, Mt. Barker.	28	9	15	15	9	76
F. S. Morris, Harvey.	35	8	11	11	9	74
H. J. Jay, Yanmah.	36	7	10	10	9	72

The following are particulars regarding the methods of cultivation, fertiliser, etc.:—

	H. Brown.	C. Candy.	F. S. Morris.	H. J. Jay.
Date Weight taken ...	20–4–34	26–2–34	5–2–34	16–3–34
Drills apart	24 inches	72 inches	27 inches	24 inches
Average height ...	3ft. to 14ft.	7ft to 8½ft.	7ft. to 7½ft.	3ft. to 14ft.
Fertiliser—Rate per acre	No. 3 Potato Manure: 300lb. per acre	Super and Ammonia No. 2: 250 lb. per acre	"C" Potato Manure: ½-ton per acre	4 parts Super 1 Sulph. Ammonia, ½ Sulph. Potash at rate 400 lb. per acre
Soil	Sandy loam	Grey to red loam, slightly gravelly	Grey to chocolate loam with gravel ridges	Sandy
Rate of Seeding ...	Maize 25 lb.	Maize 28 lb., Kale 24 oz.	Maize 40 lb.	Maize 40 lb.
Date of Seeding ...	12th and 26 January	14th and 28th November	24th October onwards	3rd December onwards
Germination ...	...	90 per cent.	80 to 95 per cent.	...
Estimated weight per acre (tons)	28·05	11·02	21·21	21 61
Area	...	3 acres	3¼ acres	...
Cultivation	...	Twice ploughed, cross harrowed and rolled	Twice ploughed, harrowed and rolled	...

THE POULTRY FARMERS' TRINITY.

"BREEDING," "WEEDING," "FEEDING."

G. D. SHAW,
Poultry Adviser, Department of Agriculture.

West Australian poultry farmers are realising how very necessary it is to lower the cost of production. Formerly it was not considered essential to apply science to the breeding, etc., of fowls for eggs or flesh, but now more and more poultry farmers are turning to science to aid them with them problems.

BREEDING.

For some considerable time, breeders of blood stock have considered it necessary to study breeding lines, and have each year developed those lines to a well thought out plan to attain their objective.

Good breeders are persistently endeavouring to combine size, shape, egg production, and colour in a bird which will be pleasing to the eye, while at the same time returning a high profit whether it be from eggs or flesh. Only those who are prepared to study and apply scientific knowledge of breeding in order to obtain that ideal can hope to succeed in the race for cheap production and a substantial profit.

The poultry farmers' trinity should be "Breeding," "Weeding," and "Feeding." Breed the best, weed out all but the best, and feed the best properly.

Fowls are classified into breeds by their shape and plumage, and no matter how good a bird's plumage, unless it conforms to the typical shape of its breed, it should not be placed in a breeding pen. By consistently breeding from shapely birds, breeders standardise their breed. Such shape embodying length, width, and depth defines "type." Unless a bird conforms to its breed type, discard it.

Western Australia has in the past concentrated on Australorps and White Leghorns, but of recent years Rhode Island Reds are beginning to make progress as utility birds. Only by the strict adherence to the type required for the Austra-

lorp breed, will breeders produce birds rising to the capabilities of Australorps. The same applies to all breeds whether for eggs or flesh.

One might be pardoned for suggesting that very few who hatch chicks from their own stock understand the type of the breed they are keeping, but such is unfortunately the case. "A breeding pen consists of one cock or cockerel mated to 8 to 12 hens according to heavy or light breeds." By accepting that bald sentence the poultry industry has caused itself untold difficulty and financial loss.

Realise early that the cock or cockerel must be the best bird of its breed obtainable. He must have all the capabilities of a sire able to produce his like, and whose progeny will so develop as to be capable of reproducing a flock of birds equal to, if not better than, the original sire.

The hens should be uniform and according to type, and they also must be able to reproduce stock which conforms to the ideal. Frequently there is the temptation to use a hen whose only claim to a place in the breeding pen has been high egg production, but it is better to discard the record layer which fails in type and substitute a hen combining type and vitality with egg-laying capacity even though the number of eggs laid is far less than the production of the record breaker.

A few breeding pens of select stock will pay better than trying to breed from numbers of birds, many of which cannot reproduce progeny of "type."

Type has been developed by those who have scientifically concentrated on all the points essential to maximum production, and by concentrating on type, those breeders will produce more profitable birds than breeders whose practice has been to use the high producer no matter what faults may be present.

When selecting breeding pens, select a cock or cockerel which conforms as nearly as possible to the type of his particular breed and whose mother had a good production of large eggs. He should be full of vitality and "boss" of the farm. The hens should show vitality and type and be producers of many large eggs.

If both sexes are birds of type and vitality, the matings will result in easily hatched and reared chicks, a large proportion of which will develop into birds typical of the breed and of good average egg production.

WEEDING.

No matter how good the breeding pen, the resultant flock will always carry birds which are not typical of their breed, lack vitality, are undersized, and not good "doers." To weed out those unprofitable birds is as important to successful poultry farming as strict attention to the breeding pens. It would not be out of place to say that weeding or "culling" (its common name) is not practised in Western Australia as it should be, partly through lack of confidence in ability to discriminate, but more through ignorance of its necessity.

From the time the eggs chip, the poultry farmer should rigidly cull his flock.

A weakly chick should be killed, chicks which fall behind in the race to maturity should be eliminated, and any that do not fill the requirements of type should not be tolerated.

Right throughout the bird's life, it should be continually subject to a search for faults, which, having been found, should cause the discard of the bird.

Constantly handle the birds. This helps poultry farmers to compare the best with the worst and teaches the breeder the faults in mating.

Rigid culling keeps down the feed bill and also allows of more time being spent on those birds which make the farm profitable. It is better to have 500 fowls all producing at a profit than 1,000 birds, 400 of which are not earning their feed. Complaints of poultry farming not paying generally indicate that the farmer does not cull his flock.

With a little practice the efficient culling of the "waster" is easily attained. Look for the prominent eyes, alert action, clean face, long and deep body, wide back, balanced carriage, and a general air of business. Then keep on handling.

Continuous handling provides comparisons, and with practice and careful observations the poultry farmer will generally be unconsciously classing his birds as "good," "medium," or "bad." For a start, put the "medium" and "bad" in separate yards for a period to confirm the opinion.

When the farmer is practised, the necessity of confirmation is not required, and the indifferent producer is marketed early. Feeding is lightened, time is saved, and the space so vacated used by profitable stock.

If trap nests are used, the culling is easy and sure, and no farmer who operates trap nests should ever be carrying a "passenger."

FEEDING.

Having satisfied oneself that all the birds now on the farm are profitable, correct feeding must be observed.

The pedigree of a bird is governed by the quality and quantity of the food the bird eats and *digests*.

Many farms are stocked with birds which are starving amidst plenty because they are not receiving a balanced ration. The right proportion of proteins to carbohydrates is not being fed.

Science and its application has proved that to obtain the best from all stock it is necessary to feed an easily digestible ration composed of constituents which should keep the stock in an athletic condition and allow the birds a surplus to make eggs.

The balance is 1 of protein to 4.5 or 4.8 carbohydrates and fats. If the ratio is less than 1:4:5 it is termed "narrow." If greater than 1:5 it is called "wide."

The blending of the available feeds in such a way as will ensure tissue building and eggs can easily be accomplished by the intelligent application of science.

The practice in Western Australia is to feed a mash in the morning with wheat as an evening grain.

The mash is "narrow," *i.e.*, is constituted of ingredients which have a high proportion of protein. The wheat is "wide" (high in carbohydrates and fats). One must feed only sufficient mash and wheat in right proportions in order that the medium between "narrow" or "wide" is obtained.

If the ration quantities are rigidly adhered to without taking into consideration the condition of the birds, the balance is upset and more harm than good is done.

It is readily understood that at certain periods of the year birds (like humans) do not "feel like eating," and so both morning and evening meals should be reduced in proportion—not one or the other alone drastically cut down.

Many poultry farmers will agree that the practice is to feed about 5 p.m. The farmer is tired, so are his attendants. A yard of 150 fowls *should* eat two gallons of wheat, and so that yard is given its quota and forgotten until next

morning, when the mash is taken round. A large portion of the mash is left and collected at various periods after feeding and given to the birds, say, at noon. At night the wheat is again given and again forgotten until one finds that the mash is nearly all left. The birds go off the lay and the egg basket stays empty.

By feeding the wheat an hour earlier and by rationing it out to each flock, one can gauge whether the birds are hungry. If they do not approach the attendant eagerly only a small portion of wheat should be given and supplemented until they are satisfied, but never more than 2 ozs. per bird. If half the normal quantity satisfies their hunger, the farmer is saving money directly and also ensuring that the birds will be ready for their morning mash. If any wheat is left on the ground or in the litter, the birds consume it in the morning before sunrise, and they are already half fed before the mash is brought to them, so they receive an unbalanced ration by consuming more wheat in proportion to mash.

The whole aim in intelligent feeding is to make the birds consume the right quantity of mash in relation to grain. By doing this the birds are kept in that athletic condition so necessary for egg production.

The mash should be so balanced that the concentrates (bran, pollard or wheatmeal, oilcake, linseed meal, meat meal, bone meal) give a completely satisfying feed of egg producing qualities when fed with the right proportion of wheat. It should also have sufficient bulk in order to allow of complete digestibility of nutriments. The quantities generally given are complete in themselves, and only need the correct application to obtain the maximum results.

Four gallons of mash should be sufficient for 50 to 60 birds, but seven pints of grain is all that is necessary, so it is obvious that after the grain feed the crop is far from full. To satisfy the bird's hunger, always feed chaffed green after a wheat ration.

If birds eat only half the normal quantity of grain, they should require only half the normal quantity of mash, and this principle should be applied until the flock is again consuming its maximum quantity.

THE GLUT PERIOD OF EGG PRODUCTION.

G. D. SHAW, Poultry Adviser, Department of Agriculture.

From August until well into December the fowls will be laying their best and producers are preparing for the export of the surplus.

It is a near-sighted policy to allow the other fellow to export while you reap the benefit of his labours.

From August to December is a busy season on the poultry farm. The hatching season is in full swing at the time export commences and care of the growing chicks consumes the farmer's time until the exporting finishes. Therefore it behoves all to make the work as light as possible, but in endeavouring to lighten work export requirements must still be respected.

Collecting eggs frequently saves cleaning; packing when collected preserves a routine, and frequent marketing ensures quality.

Export during the last few years has increased enormously, indicating that the farmer understands its necessity in order to hold the local market prices and also to introduce as much new money into Western Australia as possible.

The prominent local export firms deal direct with the producers and advance within a few pence of the estimated value of the eggs. They supply cases, fillers,

etc., and attend to all the necessary railing. A Pool is formed of growers consigning through those agents and all participate in the profits. This does not apply with those firms who buy outright. The grower should realise that the outright buyers pay only what is considered will allow of a profit. The pooling system gives that profit back to the grower.

Export is the only salvation of the industry as it is at present constituted. So many farms are carrying birds which will only lay in spring that the market is depressed, so export has come to stay.

When forwarding eggs for export:—

(1) Brand the case distinctly "For Export."

(2) Collect eggs at least twice daily.

(3) Pack only clean eggs. Any egg not clean should be wiped with a damp cloth.

(4) Store eggs in a cool place free from draughts.

(5) Market them as often as possible. Seven times a week is not too often.

Number (5) condition must be amplified.

The country producer is the cause of depressed prices in that the greater proportion of his eggs are not marketed properly. This disparity in quality in comparison with metropolitan eggs is being broken down but more is needed. It is a well-known fact that the farmer who comes into town once a week also brings the week's supply of eggs and hands them to the grocer in exchange for cash or kind and, as the farmer's day is usually Saturday, it means that the country storekeeper does not place those eggs on rail until Tuesday at the earliest. They arrive in Perth on Wednesday and are candled and examined on Thursday, about 11 or 12 days after being laid. The result is that very few, if any, are fit for export.

If the producer would only realise that the storekeeper is not going to receive export prices for those eggs, he would understand why only 5d. or 6d. is paid to him.

(6) Pack air cells upwards. This is very important for many eggs packed air cells downwards, when candled, show enlarged cells and are rejected as stale, when they are really fresh.

Above all treat the production of eggs as a business and not as an encumbrance.

(7) During the export season country farmers should deal direct only with export floors with the object of securing the highest returns. This aim is frustrated if producers consign eggs and take goods in exchange. It is common knowledge that if a store has a surplus of eggs that surplus is forwarded to an export floor for disposal, which means that the store is reaping a profit both ways. The store has to take delivery at railhead, sort and then reload for delivery to the export floor. Such handling damages the eggs and the returns are short of expectation with the result that the store can only pay low prices to the producer. In any case, the store is not handling eggs for nothing; the price given must allow of a profit although the store does not handle the sale of the eggs.

By sending direct to export floors the eggs are paid for on quality, and all profits are returned to the producer. No producer should allow a store to trade in his surplus eggs.

Cases can be instanced where the producer has been paid 8d. per dozen and those same eggs were forwarded to an export floor and netted the storekeeper 10½d. to 11d. without any extra handling whatsoever.

Therefore send all eggs produced from July to December to export floors direct and have that 2½d. for yourselves.

FIELD EXPERIMENTS WITH WHEAT AND OATS, 1933.

I. Thomas, Superintendent of Wheat Farms.

Although over the greater part of the Wheat Belt the total rainfall for the conventional growing period (May to October) was about equal to the average, the incidence of the precipitations was not altogether satisfactory.

Following upon the dry summer and autumn the seasonal winter rains did not commence until the beginning of the last week in May. This gave no opportunity for weed destruction prior to seeding some of the crops and, consequently, many of those sown on a dry seed bed suffered considerably from weed competition. Crops planted after the commencement of the rains suffered less in this direction, and in most cases the results were more satisfactory.

The rainfall for May, June and July was above the average, and in some districts trouble was experienced through waterlogging. During September a dry and rather anxious period was experienced. However, the crops withstood this better than might have been expected.

The experience of this season indicated that, when weeds are likely to be troublesome, it is desirable to wait for the rains before seeding. This may entail the planting of suitable early and very early maturing varieties, and farmers would do well to retain a reserve supply of seed of a variety such as "Noongaar" wheat in anticipation of a late opening to the season.

The results of the experiments conducted at the Wongan Hills Light Lands Farm and the Salmon Gums Experiment Farm are given below. The results of the experiments at the Dampawah, Yilgarn, Merredin and Chapman Experiment Farms have been published in the March issue of this Journal.

The superphosphate used throughout the experiments had a phosphoric acid content of 22 per cent.

WONGAN HILLS LIGHT LANDS FARM.

Farm Manager—A. R. Venton.

The monthly rainfall for the year, together with those of 1932, and the average for 20 years, are as follow—

Year.	Jan.	Feb.	Mar.	April.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1933	9	11	10	5	208	389	191	232	81	159	1,260	43	15	1,353
1932	50	13	119	95	292	134	393	554	76	178	1,627	6	24	1,934
Average, 20 years	35	49	88	72	202	274	278	211	125	96	1,186	35	56	1,521

The season opened on 21st May, over two inches of rain falling during the succeeding six days, while the rainfall for the month of June was over an inch above the average. The unusually wet, cold conditions which prevailed proved very

unfavourable for this class of country and all growth was considerably retarded. Comparatively dry conditions were experienced during the first three weeks of August, and towards the end of that month the crops were far from promising, being backward. As the weather became warmer, however, particularly during October, better growth was made by the crops, which improved considerably.

The experiments were conducted on the smokebush and tussocky type of sand-plain.

The land had been ploughed with a disc-cultivating type of plough to a depth of 3 to 4 inches during the previous winter months. During September and October it was again disced 2 inches deep with the same implement and cultivated with tandem disc harrows during late March and early April. Immediately prior to planting ordinary heavy harrows were used.

The experimental plots were each one-eighth of an acre in area, replicated five times and each treatment compared with an adjacent control.

The results of the field experiments conducted during 1933 are tabulated below—

RATE OF SEEDING EXPERIMENT WITH WHEAT.

To determine the most economical rate of planting a midseason free-stooling variety.

Planted on 12th May, 1933. Variety—Nabawa. Superphosphate—120 lbs. per acre.

Rate of Seed per acre.	Computed Yields per acre					Average Yield per acre, 1933.	Percentage Yield 1933.	Average Yields per acre 1925-33.	Percentage Yields, 1925-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
60 lbs.	17 36	17 4	17 52	18 32	20 32	18 19	103	16 27	103
45 lbs.	16 48	17 12	18 8	18 0	18 40	17 46	100	15 58	100
90 lbs.	17 44	18 40	18 16	19 44	20 8	18 54	106	16 26	103

To determine the most economical rate of planting an early, sparse-stooling variety.

Planted on 16th May, 1933. Superphosphate—120 lbs. per acre. Variety—"S.H.J."

Rate of Seed per acre.	Computed Yields per acre.					Average Yield, per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1925-33.	Percentage Yields 1925-33.
	Sec. 1.	Sec. 2.	Sec 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
60 lbs.	13 12	14 56	14 16	14 16	13 28	14 2	102	13 31	102
45 lbs.	13 20	13 44	14 40	14 24	12 32	13 44	100	13 18	100
90 lbs.	14 8	14 0	14 40	15 20	13 52	14 24	105	13 54	104

Although this year's results show slightly heavier yields from the heavier rates of seeding, the average results, obtained over a period of nine years, indicate that no appreciable advantage is gained by increasing the rate of seeding above 45 lbs. per acre.

TIME OF PLANTING EXPERIMENT.

To determine the most suitable month for planting a midseason-maturing variety.

Variety—Nabawa. Seed—45 lbs. per acre. Superphosphate—120 lbs. per acre.

Time of Planting.	Computed Yields per acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1928–33.	Percentage Yields, 1928–33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb	bus. lb.	bus. lb.	bus. lb		bus. lb.	
April 15th	12 8	14 32	14 16	9 36	11 4	12 19	85	16 8	107
May 15th	14 48	16 56	15 36	10 56	13 52	14 26	100	15 2	100
June 15th	16 48	18 48	17 36	15 52	16 56	17 12	119	10 8	67

To determine the most suitable month for planting an early-maturing variety.

Variety—Gluyas Early. Seed—45 lbs. per acre. Superphosphate—120 lbs. per acre.

Time of Planting.	Computed Yields per acre.					Average Yield, per acre, 1933.	Percentage Yields, 1933.	Average Yield per acre, 1928–33.	Percentage Yields, 1928–33
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
June 15th	11 48	10 16	15 20	12 24	11 12	12 48	147	10 32	74
May 15th	10 32	6 56	9 28	8 32	8 8	8 43	100	14 10	100
July 15th	11 12	10 0	12 56	8 40	6 40	9 54	113	6 21	45

The results this year indicate a decided advantage in favour of the later seeding. However, the average results, obtained over a period of six years, show definitely that, in normal seasons, it is advisable to plant early and to have all the seeding completed by the end of May.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Rate of Application of Superphosphate Experiment, Wongan Hills Light Lands Farm, 1933.

The centre plot received no superphosphate. The one to the left received a dressing at the rate of 75 lbs. to the acre and that on the right a dressing at the rate of 150 lbs. per acre.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

(No. 1.)

To determine the most profitable amount of superphosphate to apply to the wheat crop.

Planted on 5th May, 1933. Variety—Nabawa. Seed—45 lbs. per acre.

Rate of Application of Superphosphate.	Computed Yields per acre.					Average Yields, per acre, 1933	Per-centage Yields, 1933.	Average Yields per acre, 1929–33.	Per centage Yields, 1929–33.
	Sec. 1.	Sec. 2.	Sec 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
225 lbs.	16 40	16 48	17 36	18 32	17 4	17 20	104	17 9	105
150 lbs.	16 24	15 36	17 4	17 28	16 56	16 42	100	16 18	100
300 lbs.	17 36	17 36	18 40	19 28	18 40	18 24	110	17 23	107

(No. 2.)

Planted on 5th May, 1933. Variety—Nabawa. Seed—45 lbs. per acre.

Rate of Application of Superphosphate.	Computed Yields per acre.					Average Yields, per acre, 1933.	Per-centage Yields, 1933.	Average Yields per acre, 1929–33.	Per-centage Yields, 1929–33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
75 lbs.	12 24	12 40	12 8	11 28	10 40	11 52	71	12 19	78
150 lbs.	17 36	18 0	17 44	17 28	13 20	16 50	100	15 50	100
Nil	0 0	0 0	0 0	0 0	0 0	0 0	0	2 32	16

This year's results confirm those of previous years, viz., that it is advantageous to apply considerably more than 75 lbs. of superphosphate on this class of land. Even at present low prices for wheat an application of at least 120 lbs. per acre is warranted.

SEASONAL PLANTING VARIETY TRIAL.

(a) *To ascertain the most suitable month to plant the late, midseason, and early maturing varieties of wheat.*

(b) *To determine the most prolific of these types.*

APRIL PLANTING

Planted on 15th April, 1933. Superphosphate—120 lbs. per acre. Seed—45 lbs. per acre.

Variety.	Maturity.	Computed Yields per acre.					Average Yields per acre, 1933.	Per-centage Yields, 1933.	Per-centage Yields. 1928-33
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.		
Yandilla King ...	Late ...	12 48	15 20	15 36	14 8	14 0	14 22	91	103
Nabawa ...	Midseason ...	16 24	17 4	18 0	14 32	13 20	15 52	100	100
Sutton	Late ...	16 0	16 24	17 28	15 44	14 0	15 56	100	*111
Bencubbin ...	Midseason ...	17 36	18 0	18 24	16 48	16 56	17 33	112	†120
Nabawa ...	Midseason ...	17 44	15 44	14 48	15 20	14 40	15 39	100	100
Gluyas Early ...	Early ...	14 40	15 20	13 28	13 52	12 48	14 2	85	93
Nabawa ...	Midseason ...	18 0	17 36	16 40	14 56	15 12	16 29	100	100
Totadgin ...	Early ...	13 44	14 24	13 44	14 8	13 52	13 58	85	‡89

* 1931–33. † 1930–33. ‡ 1932-33.

MAY PLANTING.

Planted 15th May, 1933. Superphosphate—120 lbs. per acre. Seed—45 lbs. per acre.

Variety.	Maturity.	Computed Yields per acre.										Average Yields per acre, 1933.		Percentage Yields, 1933.	Percentage Yields, 1928-33.
		Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.		
Yandilla King ...	Late... ...	16	0	16	8	15	12	13	20	14	0	14	56	97	89
Nabawa ...	Midseason ...	16	48	16	16	15	52	13	52	14	0	15	22	100	100
Sutton	Late ...	15	44	16	24	15	12	11	36	12	48	14	21	93	*92
Bencubbin ...	Midseason ...	19	12	18	24	18	8	14	0	16	48	17	18	106	†112
Nabawa ...	Midseason ...	17	36	17	44	16	32	13	44	16	0	16	19	100	100
Carrabin ...	Early ...	16	24	15	20	14	0	12	0	12	32	14	3	86	93
S.H.J.	Early ...	15	52	14	56	14	32	12	32	12	48	14	8	93	89
Nabawa ...	Midseason ...	16	24	17	44	14	48	12	48	14	0	15	9	100	100
Merredin ...	Early ...	13	20	13	28	12	8	11	12	11	36	12	21	82	‡86
Gluyas Early ...	Early ...	13	52	13	36	10	48	9	28	8	24	11	14	78	‡94
Nabawa ...	Midseason ...	16	40	18	0	15	20	12	8	10	8	14	27	100	100
Totadgin ...	Early ...	15	4	15	20	11	4	8	8	9	20	11	47	82	§83
Geeralying ...	Very Early...	17	12	16	48	11	28	13	28	11	44	14	8	94	‡84
Nabawa ...	Midseason ...	17	12	16	48	15	12	13	28	12	40	15	4	100	100
Noongaar ...	Very Early...	10	16	11	28	9	4	9	12	7	4	9	25	62	64

*1931–33. †1930–33. ‡1929–33. §1932–33.

JUNE PLANTING.

Planted on 15th June, 1933. Superphosphate—120 lbs. per acre. Seed—45 lbs. per acre.

Variety.	Maturity.	Computed Yields per acre.										Average Yields per acre, 1933.		Percentage Yields, 1933.	Percentage Yields. 1928-33.
		Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.		
Geeralying ...	Very Early...	10	0	8	24	9	44	10	16	12	48	10	14	89	*81
Nabawa ...	Midseason ...	10	48	12	8	11	20	11	52	11	20	11	30	100	100
Bencubbin ...	Midseason ...	9	52	11	36	11	36	11	4	14	48	11	47	103	†111
Carrabin ...	Early ...	8	56	11	20	10	24	7	36	12	48	10	13	86	86
Nabawa ...	Midseason ...	11	4	10	56	10	0	12	32	14	40	11	50	100	100
S.H.J.	Early ...	9	44	9	44	8	40	10	24	12	32	10	13	86	84
Gluyas Early ...	Early ...	8	48	8	8	8	8	11	52	11	44	9	44	77	88
Nabawa ...	Midseason ...	12	32	11	4	11	12	14	8	13	52	12	34	100	100
Totadgin ...	Early ...	7	20	8	0	8	32	12	8	10	40	9	20	74	‡80
Merredin ...	Early ...	6	40	10	32	9	20	13	4	13	20	10	35	88	*89
Nabawa ...	Midseason ...	9	20	10	16	11	12	14	0	15	28	12	3	100	100
Noongaar ...	Very Early ...	8	16	10	8	11	4	14	56	16	24	12	10	101	82

*1929–33. †1930–33. ‡1932–33.

These results demonstrate the suitability of late-maturing varieties for early planting (April) and mid-season varieties for later (May) planting on this class of land.

POTASH-NITROGEN EXPERIMENT.

To determine the effect upon the Wheat Crop of: (a) a Nitrogenous Fertiliser; (b) a Nitrogenous + a Potassic Fertiliser.

Planted on 4th May, 1933. Variety—Nabawa. Seed—45 lbs. per acre.

Rate of Application of Fertiliser per Acre.	Computed Yields per Acre.										Average Yields per acre, 1933.		Percentage Yields, 1933.	Average Yields per acre, 1932–33.		Percentage Yields. 1932–33.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.		bus.	lb.	
112 lbs. Sulphate of Ammonia 112 lbs. Superphosphate	20	32	21	44	22	48	20	16	20	40	21	12	121	19	6	118
112 lbs. Superphosphate	15	52	17	20	18	24	18	8	17	36	17	28	100	16	13	100
112 lbs. Sulphate of Ammonia. 56 lbs. Muriate of Potash 112 lbs. Superphosphate	22	24	22	32	24	40	23	20	22	24	23	4	132	20	7	124

This year's results confirm those of the previous year, indicating that an increased yield can be expected when a heavy dressing of a nitrogenous fertiliser is applied. During 1933 a further increase was obtained when a potassic fertiliser was also used. The gain in yield, however, does not warrant the additional cost of these special fertilisers.

RATE OF SEEDING EXPERIMENT WITH OATS.

To determine the most economical rate of planting a late, free-stooling variety.

Planted on 12th May, 1933. Variety—Algerian. Superphosphate—120 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1926-33.	Percentage Yields, 1926-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
45 lbs.	20 24	24 16	23 16	23 16	26 8	23 24	100	15 21	107
30 lbs.	23 24	22 16	23 32	22 32	25 8	23 22	100	14 22	100
60 lbs.	23 24	24 32	25 8	24 16	26 16	24 35	106	15 39	110

To determine the most economical rate of planting an early, sparse-stooling variety.

Planted on 13th May, 1933. Variety—Burt's Early. Superphosphate—120 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.				Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1926-33.	Percentage Yields, 1926-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
45 lbs.	16 0	15 8	15 16	17 32	16 4	98	15 30	102
30 lbs.	15 32	15 24	16 8	17 32	16 14	100	15 19	100
60 lbs.	14 0	15 8	14 32	16 32	15 8	93	15 39	103

Section 4 discarded owing to mistake in seeding.

The average results obtained with both varieties over a number of years indicate that no appreciable advantage is gained by sowing over 45 lbs. of seed per acre.

SALMON GUMS EXPERIMENT FARM.

L. G. Seinor, Farm Manager.

The monthly rainfalls as recorded at the farm during 1933, together with the average for the past eight years, are set out hereunder:—

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1933 ...	160	..	177	13	129	137	114	92	60	134	676	169	18	1,213
Average 8 years	47	45	100	83	140	137	141	193	79	133	823	62	56	1,276

With the exception of certain experiments on "kopi," the experiments were planted on the sandy surfaced soil typical of the more satisfactory wheat soils of the district.

The land was ploughed with a mouldboard plough during June and early July. It was then cross-cultivated with a rigid-tyne cultivator in the spring and again immediately before planting.

The season opened with a fall of 37 points on the 12th May, followed by 81 points during the fourth week of the month and 83 points on the 6th June. During July, August and September cold and, in this district, rather dry conditions, were unfavourable for rapid crop growth. Comparatively good growth was made during the spring months, however, and a satisfactory maturing period was experienced.

The results of the field experiments conducted during 1933 are tabulated below—

DEPTH OF PLOUGHING EXPERIMENT.

To determine the most economical depth to plough when fallowing for the wheat crop.

Planted on 26th May, 1933. Superphosphate—112 lbs. per acre.
Variety—"Gluyas Early." Seed—45 lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1929-33.	Percentage Yields, 1929-33.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
2 inches	13 28	14 40	14 32	15 4	15 28	14 38	94	13 51	91
4 inches	14 40	16 0	14 40	16 48	15 44	15 34	100	15 10	100
6 inches	15 20	16 48	16 24	17 20	16 32	16 29	106	15 22	101

The average results over five years indicate that there is no necessity to plough deeper than four inches.

TIME OF PLANTING EXPERIMENT.

To determine the most suitable month to plant a midseason maturing variety.

Superphosphate—112 lbs. per acre.
Variety—"Nabawa." Seed—45 lbs. per acre.

Time of Planting.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1928-33.	Percentage Yields, 1928-33.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
April 17th ...	11 20	11 36	12 24	12 0	12 48	12 2	111	14 38	106
May 19th ...	10 24	10 32	11 36	10 32	11 12	10 51	100	13 48	100
June 19th ...	8 8	9 4	8 40	7 28	8 8	8 18	76	9 21	68

TIME OF PLANTING EXPERIMENT.

To determine the most suitable month to plant an early maturing variety.

Superphosphate—112 lbs. per acre.
Variety—"Gluyas Early." Seed—45 lbs. per acre.

Time of Planting.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1928-33.	Percentage Yields, 1928-33.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
June 18th ...	7 20	9 12	9 12	6 48	7 4	7 55	53	12 21	77
May 18th ...	13 28	16 48	15 20	14 56	14 0	14 54	100	16 4	100
July 22nd ...	6 56	6 16	5 36	5 4	4 48	5 44	38	9 54	62

The results this year, and the average results for six years, have shown that a midseason variety planted in April yields better than when planted in May or June, and that an early variety planted in May gives better returns than when planted in April or July. The experience gained in other parts of the wheat belt, *i.e.*, that planting should be completed by the end of May, is confirmed by the experiment.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT—No. 1.

To determine the most profitable amount of superphosphate to apply to the wheat crop.

Planted on 22nd May, 1933. Variety—"Gluyas Early." Seed—45 lbs. per acre.

Rate of Application of Superphosphate.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1929-33.	Percentage Yields, 1929-33.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
225 lbs.	17 4	20 24	19 52	20 8	20 48	19 39	116	18 4	105
150 lbs.	17 12	16 56	16 8	17 12	17 12	16 56	100	17 10	100
300 lbs.	20 56	20 32	16 48	19 4	19 52	19 26	115	17 41	103

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT—No. 2.

Planted on 20th May, 1933. Variety—"Gluyas Early." Seed—45 lbs. per acre.

Rate of Application of Superphosphate.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1929-33.	Percentage Yields, 1929-33.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
Nil	5 20	5 12	6 8	5 52	5 4	5 31	31	6 52	39
150 lbs.	18 8	17 44	17 36	18 32	18 16	18 3	100	17 28	100
75 lbs.	12 40	13 28	12 48	13 4	12 48	12 58	72	15 42	90

The average results over the past five years indicate that on this class of soil it is profitable to apply dressings of superphosphate somewhat in excess of 75 lbs. per acre.

POTASH-NITROGEN EXPERIMENT.

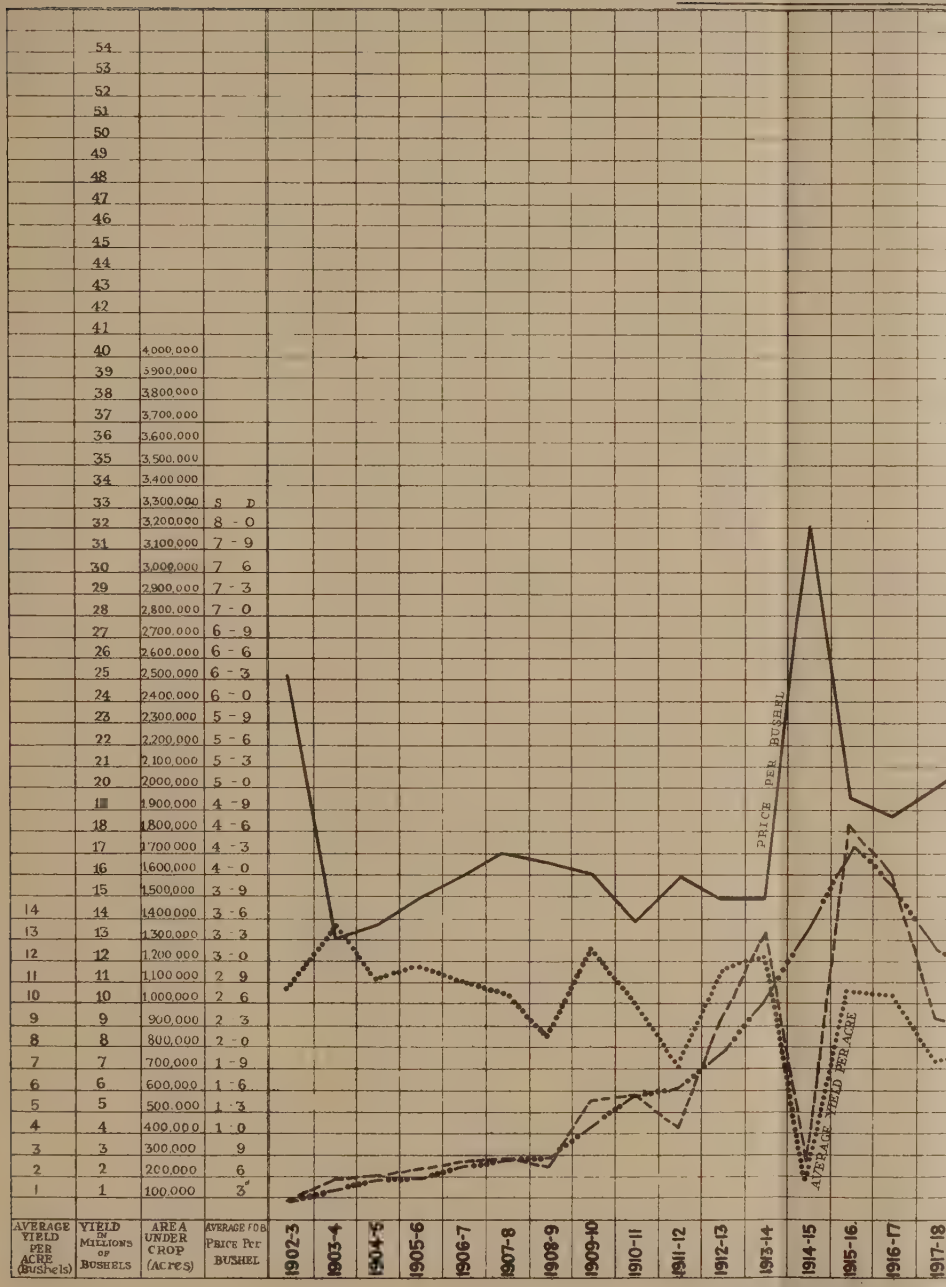
To determine the effects upon the wheat crop of—
(a) A nitrogenous fertiliser.
(b) A nitrogenous plus a potassic fertiliser.

Planted on 20th May, 1933. Superphosphate—112 lbs. per acre.
Variety—"Gluyas Early." Seed—45 lbs. per acre.

Rate of Application of Fertiliser per acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1932-33.	Percentage Yields, 1932-33.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
112 lbs. of Sulphate of Ammonia 112 lbs. Superphosphate	12 24	12 0	11 44	13 36	13 12	12 35	98	17 51	98
112 lbs. Superphosphate	12 16	12 8	12 8	14 40	12 56	12 50	100	18 10	100
112 lbs. Suplhate of ammonia 56 lbs. Muriate of Potash 112 lbs. Superphosphate	12 8	12 16	12 32	14 16	13 4	12 51	100	17 35	97

WHEAT

AVERAGE YIELD PER ACRE (Bushels) ..... TOTAL YIELD (Millions of Bush



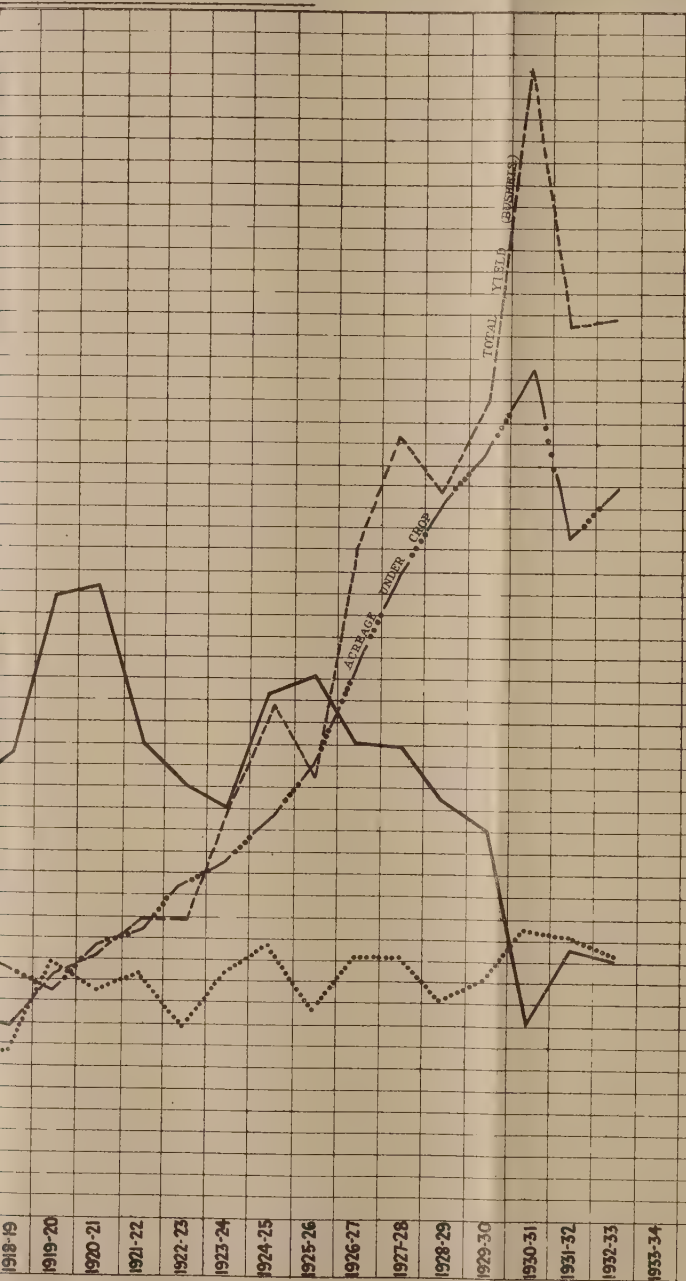
AVERAGE YIELD PER ACRE (Bushels)	YIELD IN MILLIONS OF BUSHELS	AREA UNDER CROP (Acres)	AVERAGE F.O.B. PRICE PER BUSHEL
	54		
	53		
	52		
	51		
	50		
	49		
	48		
	47		
	46		
	45		
	44		
	43		
	42		
	41		
	40	4,000,000	
	39	3900,000	
	38	3,800,000	
	37	3,700,000	
	36	3,600,000	
	35	3,500,000	
	34	3,400,000	
	33	3,300,000	S D
	32	3,200,000	8 - 0
	31	3,100,000	7 - 9
	30	3,000,000	7 6
	29	2,900,000	7 - 3
	28	2,800,000	7 - 0
	27	2700,000	6 - 9
	26	2,600,000	6 - 6
	25	2,500,000	6 - 3
	24	2400,000	6 - 0
	23	2,300,000	5 - 9
	22	2,200,000	5 - 6
	21	2,100,000	5 - 3
	20	2000,000	5 - 0
	19	1,900,000	4 - 9
	18	1,800,000	4 - 6
	17	1700,000	4 - 3
	16	1,600,000	4 - 0
	15	1,500,000	3 - 9
14	14	1,400,000	3 - 6
13	13	1,300,000	3 - 3
12	12	1,200,000	3 - 0
11	11	1,100,000	2 9
10	10	1,000,000	2 6
9	9	900,000	2 3
8	8	800,000	2 - 0
7	7	700,000	1 - 9
6	6	600,000	1 - 6
5	5	500,000	1 - 3
4	4	400,000	1 - 0
3	3	300,000	9
2	2	200,000	6
1	1	100,000	3

1902-3 1903-4 1904-5 1905-6 1906-7 1907-8 1908-9 1909-10 1910-11 1911-12 1912-13 1913-14 1914-15 1915-16 1916-17 1917-18

WESTERN AUST

FOR GRAIN

AREA UNDER CROP (Acres.) — AVERAGE PRICE Per Bushel (F.O.B.)



ALIA. 1902-1933.

The results again show that applications of sulphate of ammonia or sulphate of ammonia and muriate of potash fail to increase wheat yield on this class of soil.

EXPERIMENTS ON "KOPI" SOIL.

Owing to the unsatisfactory crops of wheat generally obtained from the so-called "kopi" soils in the Salmon Gums area, it was decided to conduct experiments with a view to obtaining definite information regarding crop response on this class of soil.

The Salmon Gums "kopi" is described as a light grey highly calcareous soil. It is fairly powdery and represents grey morrel soil of the Eastern wheat belt. With working, it tends to become a little more compact.

The original vegetation included giant mallee, a variety of *Eucalyptus obosa*, and a member of the red morrel family.

The following experiments were conducted:—

1. Fodder trial.
2. Manurial trial.
3. Seasonal planting experiment with oats.
4. Seasonal planting experiment with wheat.

SALMON GUMS—"KOPI" EXPERIMENTS.

FODDER EXPERIMENT.

To ascertain the most suitable fodder plant for this type of soil.

Planted on 18th April, 1933. Superphosphate—112 lbs. per acre.

Fodder.	Rate of Seed per Acre	Calculated Yields per Acre of Green Fodder.			Average Yields per Acre, 1933.	Percentage Yields, 1933.	Average Yields per Acre, 1931-33.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.				
	lbs.	tons.	tons.	tons.	tons.		tons.	
Noongaar Wheat	45	·54	·65	1·08	·76	43	1·70	53
Mulga Oats	40	1·30	1·84	2·16	1·76	100	3·23	100
Mulga Oats with 1 cwt. Sulphate of Ammonia	40	1·51	2·59	3·13	2·41	137	*	*
Rye	40	2·59	3·02	4·10	3·24	184	3·92	121
Wimmera Rye Grass	4	1·19	1·51	1·84	1·51	86	4·56	141
Wimmera Rye Grass with 1 cwt. Sulphate of Ammonia ...	4	1·40	2·05	2·70	2·05	116	*	*

* 1933 results only.

This year rye has shown to advantage as a source of green fodder, and Wimmera rye grass has dropped back considerably. The application of 1 cwt. of sulphate of ammonia stimulated the yields of both "Mulga" oats and Wimmera rye grass.

MANURIAL EXPERIMENT—"KOPI" SOIL.

To determine the effects of different fertilisers on the wheat crop on "Kopi" soil.

Planted 1st May, 1933. Variety—"Gluyas Early." Superphosphate—112 lbs. per acre.
Seed—45 lbs. per acre.

Treatment per Acre.	Computed Yields per Acre.			Average Yields per Acre, 1933.	Percentage Yields, 1933.	Average Yields per Acre, 1932-33.	Percentage Yields, 1932-33.
	Section 1.	Section 2.	Section 3.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.		bus. lbs.	
112 lbs. Superphosphate ... 15 tons Stable Manure ...	8 16	10 8	10 24	9 36	137	14 26	139
112 lbs. Superphosphate ...	5 20	7 12	8 32	7 1	100	10 23	100
112 lbs. Superphosphate ... 56 lbs. Manganese Sulphate	6 8	7 44	8 48	7 33	108	9 54	95

The results confirmed those of last year, *i.e.*, that heavy dressings of stable manure in addition to superphosphate will definitely increase grain yields.

SEASONAL VARIETY TRIAL—OATS.

"KOPI" SOIL—APRIL PLANTING.

(a) To ascertain the most suitable month to plant late, mid-season and early varieties of oats.
(b) To determine the most prolific of these varieties.

Planted on 18th April, 1933. Superphosphate—112 lbs. per acre. Seed—40 lbs. per care.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per Acre, 1933.	Percentage Yields, 1933.	Average Yields per Acre, 1931-33.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
Mulga ...	Early ...	10 0	10 32	9 24	8 16	9 24	9 27	113	13 33	95
Algerian	Late ...	8 16	8 32	9 8	8 0	8 16	8 22	100	14 19	100
Guyra ...	Mid-season	8 0	8 16	7 24	7 24	9 8	8 6	95	15 10	105

SEASONAL VARIETY TRIAL—OATS.

"KOPI" SOIL—MAY PLANTING.

Planted on 20th May, 1933. Superphosphate—112 lbs. per acre. Seed—40 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per Acre, 1933.	Percentage Yields, 1933.	Average Yields per Acre, 1931-33.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
Mulga ...	Early ...	6 16	6 32	5 24	6 16	6 16	6 13	99	15 24	123
Algerian	Late ...	5 24	4 0	6 16	7 24	8 16	6 16	100	12 26	100
Guyra ...	Mid-season	5 24	4 0	7 24	8 32	9 8	7 2	110	13 34	110

Although this year "Mulga" was the best yielder in the April planting section, the average results indicate that "Guyra" is likely to give the best results for early planting. In the May planting section "Mulga" did not show to such advantage as in previous years, but the average results show that it is the best variety for later planting.

SEASONAL VARIETY TRIAL—WHEAT.

"KOPI" SOIL—APRIL PLANTING.

(a) To ascertain the most suitable month to plant the mid-season, early and very early varieties of wheat.
(b) To determine the most prolific of these varieties.

Planted 18th April, 1933. Superphosphate—112 lbs. per acre. Seed—45 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per Acre, 1933.	Percentage Yields, 1933.	Average Yields per Acre, 1931-33.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
Gluyas Early	Early ...	8 48	6 40	6 56	8 48	5 36	7 22	115	9 36	108
Nabawa	Mid-season	8 32	5 52	5 52	7 12	4 32	6 24	100	8 51	100
Noongaar	Very Early	3 28	3 28	3 12	2 8	1 52	2 50	44	7 10	81

SEASONAL VARIETY TRIAL—WHEAT.

"KOPI" SOIL—MAY PLANTING.

Planted on 17th May, 1933. Superphosphate—112 lbs. per acre. Seed—45 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per Acre, 1933.	Percentage Yields, 1933.	Average Yields per Acre, 1931-33.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
Gluyas Early	Early ...	7 44	5 20	6 24	5 36	6 24	6 18	133	7 10	115
Nabawa	Mid-season	6 40	4 16	4 16	3 44	4 48	4 45	100	6 14	100
Noongaar	Very Early	4 32	3 12	2 56	2 40	3 44	3 25	72	5 19	85

For planting in either April or May on this class of soil, "Gluyas Early" has again demonstrated its superiority over the Standard mid-season and very early varieties.

FURTHER FIELD EXPERIMENTS WITH MANGANESE AS A CONTROL OF GREY SPECK DISEASE IN WESTERN AUSTRALIA.

By A. S. WILD,
Agricultural Adviser.

The value of manganese as a fertiliser has been studied in various centres in the West Australian wheat belt and also in the clover belt of the South-West portion of the State (Teakle, Thomas & Hoare, 1933).

The results of these earlier experiments indicate that no significant increase in the yield of either cereals or pastures could be expected from applications of 56 lbs. of manganese sulphate per acre except, perhaps, in the case of the lateritic sand-plain soil similar to that at Wongan Hills. The slight acidity of this soil is correlated with an extremely low content of total hydrochloric acid soluble and replaceable manganese. The unavailability of manganese in this instance was correlated with an actual deficiency of manganese in the soil.

A neutral or alkaline soil reaction would contribute to the unavailability of soil manganese. Experiments on the highly calcareous soils of the wheat belt, however, failed to produce a significant increase following the application of manganese sulphate at the rate of 56 lbs. per acre.

Grey speck disease has been described and the occurrence in Western Australia noted by Carne (1927). This disease occurs, in this State, in small patches in which both wheat and oats are affected. It is apparently confined to a limited range of country in the vicinity of the Great Southern railway. Principally it occurs on high-level, powdery soils, usually containing ironstone gravel.

Investigations in South Australia and in North-West Europe have shown that the disease is almost certainly due to a deficiency of available manganese.

Continual recurrence of the disease on the property of Mr. Alan Murray, of Tinkurrin, had led to the recommendation that manganese sulphate be applied to the small affected areas. A rough field experiment conducted in 1932, when approximately 1 cwt. of manganese sulphate per acre was applied to a small area, led to an apparent increase in yield both with wheat and oats. A calculation assessed the increase in the wheat yield as approximately 6 bushels per acre, or 50 per cent.

It was, therefore, decided to conduct a field trial in order to obtain further information and results which would correlate with those obtained in various parts of the wheat belt in 1931, as recorded in the September, 1933, issue of the "Journal of Agriculture."

This experiment was located about two miles south of Tinkurrin siding. The land under test was a high-level, gravelly, powdery soil which originally carried manna gum, morrel and odd salmon gum timber. It had been cleared for many years and, when cropped, showed definite signs of grey speck disease.

During July, 1932, it was ploughed to a depth of 3½ to 4 inches with a mouldboard plough. This was followed by a spring-tyne cultivation in September and again in March after rain. The plots were planted on May 16, with a combined cultivator-drill with light drag harrows attached. The variety "Bencubbin" was planted at the rate of 45 lbs. per acre, and superphosphate was applied to all plots, each quarter of an acre in area, at the rate of 112 lbs. per acre. The control plots received no manganese dressing, but to the adjoining plots manganese sulphate at the rates of 56 lbs. and 14 lbs. per acre respectively was applied.

The following are the rainfalls as recorded at the nearest official recording station (Tovil) during the year, together with the average monthly rainfall recordings over a period of 23 years:—

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
1933	130	47	132	36	240	302	159	121	113	138	1,073	5	*Nil*	1,423
Average, 23 yrs.	45	59	82	105	201	237	254	198	155	112	1,157	53	52	1,553

By early July, the control plots (not treated with manganese sulphate) were showing definite signs of grey speck disease. By the middle of August the disease had appeared in both the plots treated with 14 lbs. of manganese sulphate per acre and had become considerably worse in one of the untreated plots. As the season advanced the wheat on the manganese plots recovered from the grey speck disease, but that on the badly affected areas on the untreated plots failed to mature.

The following are the results obtained from the experiment:—

Variety—Bencubbin. *Rate of seed*—45 lbs. per acre.

Planted 16th May, 1933. *Rate of 22% super*—112 lbs. per acre.

Rate of Manganese Sulphate per Acre.	Computed Yield per Acre.		Average Yield per Acre.	Percentage Yield.
	Section 1.	Section 2.		
	bus. lbs.	bus. lbs.	bus. lbs.	
56 lbs.	16 28	14 28	15 28	114
Nil	16 44	10 24	13 34	100
14 lbs.	19 24	24 12	21 48	161

Observations made during the course of the experiment, and the results obtained from Section 2 where grey speck disease was most in evidence, indicate that the disease may be controlled by the application of manganese sulphate at the rate of somewhat more than 14 lbs. per acre applied at seeding.

The disease manifests itself in patches of such variable occurrence that the plot yields do not reflect accurately the effect of the manganese sulphate on the diseased patches which failed to mature where not treated with the fertiliser. There is no doubt that, where these patches due to grey speck disease occupy a considerable area in a paddock, manganese sulphate, in addition to superphosphate, can profitably be used as a fertiliser. A dressing at the rate of from 14 to 28 lbs. per acre should be adequate.

In order to ascertain whether the appearance of the disease could be correlated with certain soil properties, an analysis was made in the Government Chemical Laboratory with the results recorded in Table 2.

Both samples are identical with respect to manganese soluble in hydrochloric acid. The amount compares favourably with other soils in Western Australia where no response is shown. The reaction (ph) is slightly acid and on neither of these scores would a deficiency of available manganese be expected. In common with observations in the Eastern States, the disease has shown up on soils of a powdery structure, and the factors connecting manganese availability and this structure have not been determined.

Summary.—Experiments are described showing the effect of managanese sulphate in curing grey speck disease of wheat on powdery soils at Tinkurrin.

The disease occurs on slightly acid, non-calcareous soils containing a considerable proportion of ferruginous (lateritic) gravel.

Table 2.

RESULTS OF ANALYSIS OF SOILS FROM A PATCH AFFECTED WITH GREY SPECK DISEASE AND FROM NORMAL CROP ADJACENT.

Samples from Plots not treated with Manganese Sulphate.

Crop.	Sample 1. Affected with Grey Speck Disease.	Sample 2. Normal Crop 5 yards from Sample 1.
Depth (inches)	0—9	0—9
Stones (above 2mm.)	49	42
Manganese soluble in hydrochloric acid as per cent. fine earth (moisture free)—	per cent.	per cent.
as manganese (Mn)	0·0078	0·0078
as manganese oxide (Mn_3O_4)	0·0306	0·0306
Mechanical analysis—		
Coarse sand	42·1	36·8
Fine sand	40·5	33·8
Silt	5·1	5·5
Clay	8·0	15·6
Loss on acid treatment	4·8	0·2
Moisture	1·1	1·9
Loss on ignition	5·3	9·3
ph. (quinhydrone 1 soil to 2·5 water) ...	6·48	6·36

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FALLOW COMPETITIONS, 1934.

A. S. WILD, B.Sc. Agr., Agricultural Adviser.

During the early portion of this year nine district agricultural societies conducted fallow competitions. In each case the inspection of the competing fallows and the allocation of awards was made by officers of the Department of Agriculture.

The scale of points under which the awards were made was as follows:—

Moisture	40 points
Condition of Mulch	10 ,,
Freedom from Weeds	10 ,,
Consolidation of Seed bed	20 ,,
Uniformity of Preparation	20 ,,
Total	100 points

Except where otherwise specified the competition plots were 50 acres in area.

KARLGARIN AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

In the competition conducted by the above society six entries were submitted for inspection. Judging took place during January, the awards being made as follow:—

Competitor.	District.	Moisture 40 pts.	Mulch. 10 pts.	Freedom from Weeds, 10 pts.	Consolidation of Seed Bed 20 pts.	Uniformity of Preparation, 20 pts.	Total. 100 pts.
Mouritz, W. ...	Hyden ...	36	9	8	19	17	89
Marshall, H. J. ...	Hyden ...	35	9	8	19	17	88
Green & Atkinson ...	North Hyden	37	9	7	16	18	87
James, S. W. ...	Karlgarin ...	35	9	9	16	17	86
Medcalf, C. W. ...	Karlgarin ...	33	8	8	18	18	85
Richter, C. L. ...	Karlgarin ...	34	8	8	17	18	85

The winning entry was that of Mr. W. Mouritz. The land, which originally carried salmon, gimlet and morrel timber, had been tilled with a rigid-tyne scarifier to a depth of 3½ inches during the previous July. This cultivation was repeated early in the following month, and again to a depth of 2½ inches during late August.

The rainfall recorded from June to January, inclusive, is shown in the following table:—

Centre.	Fallowing rains.				Spring rains.			Summer rains.				Total June to January.
	June	July	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Total.	
Karlgarin East	186	121	177	484	60	86	146	17	33	5	55	685
Hyden South	145	135	160	440	59	130	189	42	11	17	70	699
Hyden North (Camel Peak)	158	153	168	479	64	168	232	*	*	14	...	*

* Not available

The cultural details of the competing fallows are summarised in the following table:—

CULTURAL DETAILS.

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of ploughing.	Condition of land at ploughing.	Subsequent cultivations.
Mouritz, W. ...	Salmon, gimlet, morrel	...	July	Rigid-tyne scarifier	inches. 3½	Good	Rigid-tyne scarified 3½ins. deep in early August and again 2½ins. deep late in August.
Marshall, H. J. ...	Salmon, gimlet, morrel	1932 ...	July	Disc	4	Excellent ...	Spring-tyne cultivated in September.
Green & Atkinson ...	Salmon, gimlet, mallee	3 years ...	June	Spring-tyne cultivator	2½	Good	Spring-tyne cultivated in mid-October.
James, S. W. ...	York gum, salmon, gimlet, mallee, little morrel	1925 ...	March and April	Disc	2– 2½	Hard	Disced 2½ins. deep in August and again 2ins. deep in late September.
Medcalfe, C. W. ...	Salmon, mallee, gimlet, morrel	1924 ...	August ...	Disc	3	Indifferent ...	Disced 2ins. deep in September. Spring-tyne cultivated in October.
Richter, C. L. ...	Salmon and mallee ...	6 years ...	Late June ...	Disc	4	Good	Spring-tyne cultivated in early September.

PHILLIPS RIVER AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

Seven fallows were judged during January for the fallow competition conducted by the Phillips River Agricultural Society. Points were allocated and awards made as follow:—

Competitor.	District.	Moisture. 40 pts.	Mulch. 10 pts.	Freedom from Weeds. 10 pts.	Consolidation of Seed bed. 20 pts.	Uniformity of Preparation. 20 pts.	Total. 100 pts.
Campbell, J.	Mt. Short ...	38	9	8	19	18	92
Bebbington Bros. ...	Mt. Short ...	39	8	8	18	18	91
Dilley, A. F.	Mt. Short ...	37	9	8	17	17	88
Barrett Bros.	Ravensthorpe ...	35	9	7	18	17	86
Chambers Bros.	Ravensthorpe ...	34	8	9	16	19	86
Love, J. W.	Ravensthorpe ...	35	7	7	19	17	85
Shinner, E.	Ravensthorpe ...	35	8	9	16	17	85

Mr. J. Campbell's entry secured first place. This was on jam, salmon and mallee country which had been ploughed with a mouldboard plough during early June to a depth of 3½ inches. During November it was cultivated after rains had fallen.

The rainfall recorded from June to January, inclusive, is shown in the following table:—

Centre.	Fallowing rains.				Spring rains.			Summer rains.				Total June to January.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Total	
Ravensthorpe	156	68	189	413	104	164	268	132	109	38	279	960
Mt. Short	134	72	158	364	75	141	216	161	86	16	263	843

The cultural details of the competing fallows are summarised in the following table:—

CULTURAL DETAILS.

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of ploughing.	Condition of land at ploughing.	Subsequent cultivations.
Campbell, J. ...	Jam, salmon, mallee ...	Old land...	Early June ...	Mouldboard ...	inches. 3½	Good	Spring-tyne cultivated in late November after rain.
Bebbington Bros. ...	Mallee and sprinkling of salmon	2 years ...	Early June ...	Mouldboard and disc	3 4	Good	Spring-tyne cultivated in mid-June to full depth of ploughing.
Dilley, A. F. ...	Salmon and little mallee	3 years ...	July	Disc	3	Fair	Disced 2ins. deep in September.
Barrett Bros. ...	Salmon and gimlet ...	1933 ...	July	Disc	2½ 3	Good	Spring-tyne cultivated in early October.
Chambers Bros. ...	Gimlet and salmon ...	Old land ...	July	Mouldboard ...	3¼—4	Good	Spring tyne cultivated in September.
Love, J. W. ...	Salmon and mallee ...	1928 ...	July	Mouldboard ...	3½	Fair	Nil.
Shimer, E.	Gimlet and mallee ...	6 years ...	Late July ...	Mouldboard ...	4	Fair	Spring-tyne cultivated late September.

NUNGARIN AGRICULTURAL SOCIETY.

Judge: K. T. Lutz, Agricultural Adviser.

The inspection of the thirteen entries in the fallow competition conducted by the Nungarin Agricultural Society took place during late February. The judge's awards are as follow:—

Competitor.	District.	Moisture. 40 pts.	Mulch. 10 pts.	Freedom from Weeds. 10 pts.	Consolidation of Seed bed. 20 pts.	Uniformity of Preparation. 20 pts.	Total. 100 pts.
Dunkley, G. A. ...	Yelbeni ...	32	9	9	19	17	86
Creagh Bros., Ltd. ...	Kweikan ...	34	8	8	17	17	84
Evans, L. D. ...	Nukarni ...	32	8	8	18	17	83
Green, T. W. ...	Kweikan ...	34	8	7	17	17	83
Johnson, J. H. ...	Mangowine ...	32	8	9	17	17	83
Williams, F. A. ...	Mangowine ...	31	8	9	18	16	82
Jolly, H. P. ...	Mangowine ...	30	8	9	17	17	81
Brown, H. T. ...	Nukarni ...	28	7	9	18	18	80
Crooks, E. ...	Nukarni ...	31	8	7	18	16	80
Maughan, J. S. ...	Nukarni ...	28	8	7	19	18	80
Vernon, G. J. ...	Nukarni ...	31	8	7	18	16	80
Browne, C. T. ...	Nukarni ...	31	7	7	18	16	79
Farrell, G. C. ...	Nungarin ...	31	7	6	16	17	77

The fallow submitted by Mr. G. A. Dunkley secured first place. This land originally carried gimlet, mallee, tea-tree, and odd salmon gum timber. It had been worked during June with a rigid-tyne scarifier to a depth of three inches and disc cultivated the following month. The rigid-tyne scarifier was again employed to cultivate the land in August and also after rain in December.

The following are the monthly rainfalls as recorded from June to February at the various centres concerned in the competition:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.					Total June to February.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Feb.	Total.	
Yelbeni ...	288	159	236	683	80	93	173	88	39	53	51	231	1,087
Mangowine	230	141	161	532	94	69	163	67	49	36	52	204	899
Nukarni ...	196	154	195	545	65	99	164	31	45	104	14	194	903
Nungarin ...	275	165	157	597	56	64	120	77	49	99	24	249	966

The cultural details of the fallows entered in the competition are given below:—

Competitor.	Original Timber.	When Ploughed.	Implement.	Depth.	Condition of Land.	Subsequent Cultivations.	Sheep.
				inches			
Dunkley, G. A. ...	Gimlet, mallee, tea-tree, odd salmon gum	June	Rigid-tyne scarifier ...	3	Stiff	Disc cultivated in July; scarified in August and after rain in December	Yes
Creagh Bros., Ltd ...	Mallee, jam, salmon gum and gimlet	End of June ...	Disc cultivating plough	3½	Wet	Scarified end August; spring-tyne cultivated end of September	Yes
Evans, L. D. ...	Gimlet and salmon gum ...	End of June ...	Mouldboard	3	Good	Harrowed in July; disc cultivated in August and then harrowed	Yes
Green, T. W. ...	Salmon gum, gimlet, mallee and jam	End of June	Disc plough	3	Good	Spring-tyne cultivated in August and September	Yes
Johnson, J. H. ...	Gimlet, salmon gum and tea-tree	End of June	Disc cultivating plough	4	Good	Disc cultivated in August; spring-tyne cultivated in September	Yes
Williams, F. A. ...	Salmon gum and gimlet ..	End of June	Mouldboard	3—4	Good	Scarified in August; spring-tyne cultivated in October	Yes
Jolly, H. P. ...	Salmon gum, mallee and odd morrell	End of July ...	Mouldboard	3	Good	Spring-tyne cultivated in September; harrowed in February	No
Brown, H. T. ...	Gimlet and salmon gum ...	Beginning of July	Rigid-tyne scarifier ...	2½	Good	Scarified in August and November; rolled in January	Yes
Crooks, E.	Salmon gum gimlet and mallee	Middle of July	Disc cultivating plough	3½	Good	Spring-tyne cultivated in September ...	Yes
Maughan, J. S. ...	Salmon gum and gimlet ...	End of July ...	Disc plough	4	Fair	Spring-tyne cultivated in August, September and October	Yes
Vernon, G. J. ...	Salmon gum and gimlet ...	End of July ...	Mouldboard	2½-3	Good	Disc cultivated twice in September; harrowed at end of September	Yes
Browne, C. T. ...	Salmon gum, gimlet, jam and mallee	End of July ...	Disc cultivating plough	2½—3	Good	Spring-tyne cultivated at end of August and again at end of September	No
Farrell, G. C. ...	Salmon gum and gimlet, yorrel and tea-tree	Middle of July	Disc plough and partly with disc cultivating plough	2½	Good	Tandem disc ivated at the end of August	Yes

MUKINBUDIN AGRICULTRAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

The fallow competition conducted by the Mukinbudin Agricultural Society was judged during the last three days of February, nine entries being inspected. Details of the awards made are shown below:—

Competitor.	Centre.	Moisture 40 pts.	Mulch. 10 pts.	Freedom from Weeds. 10 pts.	Preparation of Seed Bed. 20 pts.	Evenness of Preparation. 20 pts.	Total. 100 pts.
Stickwick, W. N. ...	Karloning ...	34	8	9	19	19	89
Pearce, E. E.	Wilgoyne ...	36	8	9	18	17	88
Dixon, W.	Lake Brown ...	34	7	8	19	19	87
Shadbolt, H. J.	Mukinbudin ...	34	8	8	18	18	86
Payne, B.	Lake Brown ...	34	8	7	18	18	85
Willaims, F. A.	Nungarin ...	31	9	8	18	18	84
Manuel, C. J.	Mukinbudin ...	29	9	8	17	19	82
Clamp, A.	Mukinbudin ...	32	7	6	18	17	80
Mulqueeny, J.	Lake Brown ...	29	8	8	17	18	80

Mr. W. N. Stickwick's entry secured first place. This fallow was on salmon, mallee and gimlet country which had been disc ploughed during July to a depth of 3 to 3½ inches. The spring-tyne cultivator was then used for the three succeeding cultivations in August, September and October respectively. After rain in December the land was harrowed.

This entry was very commendable in all respects except that the mulch was a little too fine. Most of the fallows entered in this competition were at fault in this respect.

The rainfalls as recorded at the centres where the competing fallows were located are shown below:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.					Total June to February.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Feb.	Total.	
Karloning	287	90	169	546	48	90	138	81	85	Nil	29	195	879
Wilgoyne	231	87	148	466	59	52	111	128	211	Nil	16	355	932
Mukinbudin	233	112	156	501	69	78	147	84	110	41	30	265	913
Nungarin ...	275	165	157	597	56	64	120	77	49	99	24	249	966
Lake Brown	218	114	151	483	48	43	91	80	30	54	Nil	164	738

The cultural details of the competing fallows are summarised as hereunder:—

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of Ploughing.	Condition of Land at Ploughing.	Subsequent Cultivations.
					inches.		
Stickwick, W. M. ...	Salmon, mallee, and gimlet	1930 ...	Late July ...	Disc	3—3½	Good	Spring-tyne cultivated in late August, again early in September, and again in October. Harrowed in December after rain.
Pearce, E. E. ...	Mixed gimlet, tea-tree and mallee, jam and scrub	1924 ...	June	Mouldboard ...	3–4	Good	Rigid-tyne scarified in September and harrowed in November after rain.
Dixon, W.	Salmon and gimlet ...	10 years ...	Late June ...	Mouldboard ...	4	Good	Spring-tyne cultivated in August and again late in September. Harrowed in November after rain.
Shadbolt, H. J. ...	Salmon and gimlet ...	1917 ...	June	Rigid-tyne scarifier	3	Good	Rigid-tyne scarified late July 2½ins. deep and again 2ins. deep late August.
Payne, B.	Mallee and gimlet ...	1931 ...	Late June ...	Disc	3	Good	Rigid-tyne scarified 2ins. deep in August and again 2ins. deep in December after rain.
Williams, F. A. ...	Salmon and gimlet ...	Old land ...	June	Mouldboard ...	3 4	Fair	Rigid-tyne scarified in August, and spring-tyne cultivated in October.
Mannel, C. J. ...	Salmon, gimlet, morrel	1915 17 ...	Early July ...	Mouldboard ...	3½	Fair	Rigid-tyne scarified late in August, and spring-tyne cultivated in November.
Clamp, A.	Salmon, gimlet, jam	1925 ...	June	Disc	4	Good	Spring-tyne cultivated in August, and again in September. Harrowed in February.
Mulqueeny, J. ...	Salmon, morrel, gimlet	11 years ...	March, 1933 ...	Disc	4	... ...	Disced early in August and again in November, after rain. Spring-tyne cultivated in December, after rain.

SOUTHERN CROSS AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

Only three entries were received for the 150-acre fallow competition conducted by this society. These were inspected on the 6th March, awards being made as follow:—

Competitor.	Centre.	Moisture 40 pts.	Mulch. 10 pts.	Freedom from Weeds. 10 pts.	Preparation of Seed Bed. 20 pts.	Evenness of Preparation. 20 pts.	Total. 100 pts.
White, Geo. (senr.) ...	Bullfinch ...	36	8	9	18	18	89
Smith, P. J.	Turkey Hill ...	34	7	7	17	17	82
Stacey, J. B.	Southern Cross ...	35	7	6	16	17	81

The entry of Mr. Geo. White, senr., of Bullfinch, was placed first. This fallow was on salmon and gimlet country which had been disc ploughed in July to a depth of three inches. This was followed by a spring-tyne cultivation in August and a harrowing in September. This last-mentioned cultivation had left the surface of the fallow a little too fine and flat.

The following are the monthly rainfalls as recorded from June to February at the centres where the competing fallows were located:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.					Total June to February.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Feb.	Total.	
Southern Cross	213	111	202	526	37	49	86	52	69	121	...	242	854
Bullfinch	160	153	126	439	75	72	147	59	196	14	...	269	855

Below are summarised the cultural details of the fallows entered in the competition:—

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of Ploughing.	Condition of Land at Ploughing.	Subsequent Cultivations
					inches.		
White, Geo. (senr.)...	Gimlet and salmon gum	1929-30 ...	July	Disc	3	Good	Spring-tyne cultivated in August, and harrowed in September.
Smith, P. J. ...	Salmon, gimlet, mallee, jam	3 years ...	June-August ...	Disc	3	Good	Spring-tyne cultivated 3ins. deep during August to September. Portion again spring-tyne cultivated.
Stacey, J. B. ...	Morrel and tea-tree ...	1926 ...	July	Disc	4	Good	Spring-tyne cultivated in August.

MERREDIN AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

The Merredin Agricultural Society this year again conducted a fallow competition. Fifteen competition plots were inspected between the 8th and 13th of March. The awards made are as shown below:—

Competitor.	Centre.	Moisture 40 pts.	Mulch. 10 pts.	Freedom from Weeds. 10 pts.	Preparation of Seed-bed. 20 pts.	Evenness of Preparation. 20 pts.	Total. 100 pts.
Maughan, Mrs. E. M. ...	Nukarni	36	9	9	19	19	92
Teasdale, H. W. ...	Belka	35	9	9	19	19	91
Reichelt, E. E.	North Burracoppin	36	9	9	18	18	90
Barnett, L. T. C. ...	North Walgoolan	35	9	9	18	18	89
McPharlin & Sons ...	South Burracoppin	37	9	7	18	18	89
Cook, W. T.	South Burracoppin	34	8	8	19	19	88
Kaye, John	Baandee	35	8	8	18	19	88
Maughan, J. D.	South Walgoolan	36	8	7	19	18	88
Walston, R.	Walgoolan ...	34	9	9	18	18	88
Harling, H. H.	Merredin ...	34	8	9	18	18	87
Clothier, J. E.	Merredin ...	34	8	8	18	18	86
Emmett, H. C.	Goomarin ...	33	8	8	19	18	86
Flockhart, I. H. ...	Korbel	33	9	8	18	18	86
Smallacombe, T. H. ...	Merredin ...	32	7	8	17	19	83
Cockram, W. H.... ...	Nukarni	33	8	6	17	18	82

During the course of judging these fallows, rain, ranging from about 40 points at Walgoolan to about 100 points at Baandee, fell. This entailed some difficulty in adjusting the points awarded for moisture content so that no disadvantage would be placed on the fallows judged before this rain. Consequently the surface moisture was more or less disregarded and the points under this heading allocated on what moisture was apparently in the fallow (below the surface) prior to the March rain.

Mrs. E. M. Maughan's entry secured first place, being closely followed by that of Mr. H. W. Teasdale.

The winning fallow had been scarified three inches deep during April, 1933. It was again rigid-tyne scarified to the same depth during the following June, again two inches deep in August and also in September. During October it was spring-tyne cultivated, this operation being repeated after rain had fallen during March.

Mr. Teasdale's fallow had been disc ploughed to a depth of three inches during the previous June and July and then rigid-tyne scarified during August. It was then spring-tyne cultivated in September and again in March. Both these fallows were particularly good and but very little separated them.

The monthly rainfalls as recorded at the various centres are given below:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.					Total June to February.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Feb.	Total.	
Merredin ...	248	139	199	586	63	123	186	50	28	78	13	169	941
Nukarni ...	196	154	195	545	65	99	164	31	45	104	14	194	903
Belka ...	228	134	163	525	102	125	227	42	34	61	25	162	914
Burracoppin	205	132	187	524	55	63	118	44	45	30	66	185	827
Ulva ...	311	170	167	648	72	144	216	44	130	42	25	241	1,105
Walgoolan	262	160	238	660	55	49	104	68	27	*Nil*	*Nil*	95	859
Baandee ...	248	82	123	453	59	89	148	23	86	88	14	211	812
Goomarin	317	168	231	716	49	49	98	63	52	36	40	191	1,005

* Not available.

Cultural details of the fallows inspected for this competition are set out hereunder:—

CULTURAL DETAILS.

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of Ploughing.	Condition of Land at Ploughing.	Subsequent Cultivations.
					inches.		
Maughan, Mrs. E. M.	Salmon and gimlet ...	Old land ...	April, 1933 ...	Rigid-tyne scarifier	3	Dry	Rigid-tyne scarified 3ins. deep in June, again 2ins. deep in August, and again in September. Spring-tyne cultivated in October, and again in March, after rain.
Teasdale, H. W. ...	Gimlet and salmon ...	Old land ...	June and July	Disc	3	Good	Rigid-tyne cultivated in August. Spring-tyne cultivated in September, and again in March, after rain.
Reichett, E. E ...	Salmon and tea-tree ...	7 years ...	June	Rigid-tyne scarifier	3	Fair	Rigid-tyne scarified late in July and again in mid-September. Harrowed after each of the three rigid-tyne cultivations.
Barnett, L. T. C. ...	Salmon and gimlet ...	Old land ...	June	Disc	3	Good	Spring-tyne cultivated 3ins. deep in July. Spring-tyne cultivated in September and again in November. Portion spring-tyne cultivated in December, after rain.
McPharlin & Sons	Gimlet and mallee ...	4 years ...	Mid-June ...	Disc	3	Good	Spring-tyne cultivated 2½ins. deep in August, and again 2ins. deep in October.
Cook, W. T. ...	Salmon and borree ...	1924 ...	July	Disc	3	Good	Rigid-tyne scarified 3ins. deep in August, and again 2ins. deep in September.
Kaye, John ...	Mixed salmon, morrel, gimlet, tea-tree	Old land ...	June and July	Mouldboard ...	4	Good	Rigid-tyne cultivated in September. Spring-tyne cultivated in October. Harrowed in December, after rain.
Maughan, J. D. ...	Gimlet and salmon ...	1924 ...	June	Disc	3¼	Good	Disced 3½ins. deep in July. Rigid-tyne scarified 3½ins. deep in September. Spring-tyne cultivated 2ins. deep late in September.

CULTURAL DETAILS—*continued.*

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of ploughing.	Condition of land at ploughing.	Subsequent cultivations.
Walston, R. ...	Gimlet and salmon ...	1923 ...	Early July ...	Disc	3½	Good	Rigid-tyne cultivated late in September.
Harling, H. H ...	Chiefly white-gum and scrub	5 years ...	June and July	Disc	3½—4	Good	Spring-tyne cultivated in August, and again in September.
Clothier, J. E. ...	Mallee and scrub ...	Old land ...	Late June ...	Disc	3	Good	Spring-tyne cultivated in August, and again in September.
Emmett, H. C. ...	Salmon-gum, gimlet and mallee	1917 ...	Third week in June	Mouldboard ...	3- 4	Fairly good ...	Rigid-tyne scarified in July, and again the last week in August Spring-tyne cultivated and harrowed last week in January.
Flockhart, I. H. ...	Salmon and gimlet ...	Old land ...	Late June ...	Disc	3½	Hard	Disced late in July. Spring-tyne cultivated in mid-September, and again early in December, after rain.
Smallacombe, T. H.	Chiefly gimlet ...	Old land ...	Late June ...	Mouldboard ...	3½- 4	Good	Disced 3ins. deep late in August. Spring-tyne cultivated in September.
Cockram, W. H. ...	Jam, mallee, gimlet, morrel	Old land ...	March, 1933 ...	Disc	Scratched	Hard	Disced 4ins. deep late in July, and again 3ins. deep in August. Spring-tyne cultivated in September, and again in October.

BRUCE ROCK AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

The eight entries judged for the fallow competition conducted by the Bruce Rock Agricultural Society were inspected between March 14th and 18th.

Earlier March rains had increased the moisture content, commenced the germination of weed seeds and compacted the mulch of many of these fallows, and consequently they were not seen to best advantage.

The awards made are shown below:—

Competitor.	Centre.	Moisture 40 pts.	Mulch. 10 pts.	Freedom from Weeds. 10 pts.	Preparation of Seed Bed. 20 pts.	Evenness of Preparation. 20 pts.	Total. 100 pts.
Pimlott, S. H.	Kwolyin	36	9	9	19	19	92
Currie, J. J.	Bruce Rock ...	34	8	8	19	19	88
Cole, R. T.	Bruce Rock ...	34	7	9	19	18	87
Fuschbichler, M. ...	Bruce Rock ...	35	9	7	18	18	87
Stevens, D.	Bruce Rock ...	35	9	8	17	18	87
Schilling, C. E. & N. S. ...	Bruce Rock ...	34	7	9	18	18	86
Smith, C. & A. H. ...	Bruce Rock ...	33	8	9	18	18	86
Buller & Black	Babakin	36	7	7	19	16	85

Mr. S. H. Pimlott's winning fallow was, in every respect, very good. This land, which originally carried gimlet and salmon timber, had been rigid-tyne scarified three inches deep during the previous June. It was then spring-tyne cultivated in July, again in August, and again in March after rain. This working resulted in an even, well-worked fallow, free of weed growth and showing a desirable mulch and well-prepared seed-bed.

The rainfall recorded at the centres concerned with the competition are shown hereunder:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.					Total June to February.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Feb.	Total.	
Bruce Rock	211	124	133	468	87	113	200	29	44	36	Nil	109	777
Babakin ...	193	159	168	520	52	134	186	12	31	5	29	77	783
Kwolyin ...	264	117	120	501	76	133	209	23	7	46	18	94	804
Yarding ...	224	144	128	496	48	229	277	18	74	10	17	119	892

The following table shows the summarised cultural details of the fallows judged for the competition:—

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of ploughing.	Condition of land at ploughing.	Subsequent cultivations.
					inches.		
Pimlott, S. H. ...	Gimlet and salmon ...	Old land ...	Mid-June ...	Rigid-tyne scarifier.	3	Good.	Spring-tyne cultivated in July, again in August, and again in March, after rain.
Curtis, J. J. ...	Chiefly gimlet ...	Old land ...	Late June ...	Mouldboard ...	3	A little dry. ...	Spring-tyne cultivated late in August, again in early September, again early in October, and again early in December, after rain.
Cole, R. T.	Gimlet and salmon ...	Old land ...	Early July ...	Disc.	3½	Good.	Rigid-tyne scarified early in August. Spring-tyne cultivated early in September and again early in October.
Puschbirchler, M. ...	Chiefly gimlet ...	Old land ...	Mid-July ...	Rigid-tyne scarifier.	3	A little hard. ...	Rigid-tyne scarified 3ins. deep mid-August. Spring-tyne cultivated late in September, and again late in October.
Stevens, D.	Morrel and salmon ...	Old land ...	July	Disc.	3	Good.	Spring-tyne cultivated in August, and again in September.
Schilling, C. E. and N. S.	Salmon and gimlet ...	Old land ...	Early June ...	Mouldboard ...	3	Good	Rigid-tyne scarified end July, cross spring tyne cultivated September.
Smith, C. & A. H.	Salmon and gimlet ...	Old land ...	Mid-June ...	Mouldboard. ...	2½	Fair.	Rigid-tyne scarified twice.
Buller & Black ...	Gimlet, salmon, mallee	Old land ...	Late July ...	Disc.	3	Hard.	Rigid-tyne scarified in August.

KIRWAN AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

There were nine competitors in the fallow competition conducted by the Kirwan Agricultural Bureau. The competition plots were judged at the end of March.

Details of the awards made are given below:—

Competitor.	Centre.	Moisture 40 pts.	Mulch. 10 pts.	Freedom from Weeds. 10 pts.	Preparation of Seed Bed. 20 pts.	Evenness of Preparation. 20 pts.	Total. 100 pts.
Mitchell, J. A. & H. A. (Plot 1)	Kokardine ...	36	8	9	18	18	89
Joynes, G.	Kokardine ...	36	8	9	17	17	87
Mitchell, J. A. & H. A. (Plot 2)	Kokardine ...	34	8	8	17	17	84
Strahan Bros.	Kirwin	33	8	7	17	17	82
Booth, W. J.	Kokardine ...	33	6	7	16	18	80
Stanwix, E.	Kirwan ...	30	9	6	18	17	80
Broadhurst, E. & W. L.	Burakin	34	6	6	16	15	77
Leach, J.	Kirwan	31	6	6	16	16	75
Montague, J. S.	Kirwan	31	6	6	16	16	75

Most of the fallows inspected were on light country. Being a comparatively new district very few of the settlers possess sheep. The absence of stock was reflected by the fallows. Generally weed growth was very noticeable, and where efforts had been made to control these by cultivation alone the seedbed and general condition of the fallow had suffered as a result of injudicious working.

The rainfall as recorded from June to March, inclusive, is shown below:—

Centre.	Fallowing rains.				Spring rains.			Summer rains.						Total June to March.
	June	July	Aug.	Total	Sept.	Oct.	Total	Nov.	Dec.	Jan.	Feb.	Mar.	Total	
Kulja	389	134	246	769	30	70	100	60	20	49	*Nil*	56	185	1,054

The cultural details of the fallows entered in the competition are summarised hereunder:—

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of Ploughing.	Condition of Land at Ploughing.	Subsequent Cultivations.
					inches.		
Mitchell, J. A. & H. A., Plot 1	Tussocky sandplain ...	5 years ...	Late July ...	Spring-tyne cultivator.	2	Good.	Spring-tyne cultivated late in August, and again in November. Harrowed late in November, after rain, and again in February.
Joynes, G.	Mixed gimlet, jam, mallee, tea-tree	5 years ...	July	Disc.	3½	Good.	Disced 2½ins. to 3ins. in August, again 2½ins. deep in September and again 2ins. deep in February, after rain.
Mitchell, J. A. & H. A. Plot 2	Tussocky sandplain ...	4 years ...	August ...	Spring-tyne cultivator.	2	Good	Spring-tyne cultivated twice in September. Harrowed late in November after rain, and again late in February after rain.
Strahan Bros. ...	Tussocky sandplain ...	1928 ...	June and July	Disc.	4	Good.	Harrowed late in August.
Booth, W. J. ...	Salmon and gimlet ...	Old land ...	Late August ...	Mouldboard. ...	4	Drying out. ...	Nil.
Stanwix, E. ...	Salmon and gimlet ...	7-8 years...	July	Disc.	3-3½	Good.	Spring-tyne cultivated late in July. Disced 2ins. deep in September, and spring-tyne cultivated late in September.
Broadhurst, E. & W. L.	Tussocky sandplain ...	4 years ...	Late June ...	Disc.	3½ 4	Good.	Disced 2ins. deep late in October.
Leach, J.	Tussocky sandplain to mallee plain	1927 ...	June	Disc.	3	Good.	Nil.
Montague, J. S. ...	York gum and jam to scrub plain	1925 ...	July	Disc.	3	Good.	Portion disced 2ins. deep.

CARNAMAH AGRICULTURAL SOCIETY.

Judge: G. L. Throssell, Agricultural Adviser.

Only three entries were judged for the fallow competition conducted by the Carnamah Agricultural Society.

The inspection of these fallows took place during January, awards being made as hereunder:—

Competitor.	Address.	Moisture. 40 pts.	Condition of Mulch. 10 pts.	Freedom from Weeds. 10 pts.	Consolidation of Seedbed. 20 pts.	Uniformity of Preparation. 20 pts.	Total 100 pts.
Forrester, J. K. ...	Carnamah ...	37	8	7	18	16	86
Clark, R. W. ...	Carnamah ...	36	7	8	16	16	83
Adams, J. L. ...	Winchester ...	29	6	6	15	14	70

The rainfall recorded from June to December, inclusive, is shown in the following table:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.			Total June to December.
	June	July	Aug.	Total	Sept.	Oct.	Total	Nov.	Dec.	Total	
Carnamah	628	201	366	1,195	76	98	174	41	34	75	1,444
Winchester	458	161	329	948	75	88	163	44	28	72	1,183

The following table shows the summarised cultural details of the competing fallows:—

Competitor.	Original Timber.	When Cleared.	No. of Crops.	Rotation.	When Ploughed.	Implement.	Condition of Land.	Depth.	Subsequent Cultivations.
								ins.	
Forrester, J. K., Carnamah.	Heavy york gum and black wattle.	1914	10	3 years; fallow, crop, pasture.	July	Heavy disc.	Wet and cloddy	4	Rigid-type scarified in August and again end of September after rain.
Clark, R. W., Carnamah.	Salmon and york gum and little jam.	1913	6 crops in 12 years.	3 years; fallow, crop, pasture.	Mid-June	Heavy disc.	Good.	4	Springtype cultivated in August and in September; portion disc cultivated end October on account of doublegees.
Adams, J. L., Winchester.	Salmon gum	1926	4	2 years; fallow, crop.	End June.	Disc cultivator.	Good.	3–4	Cultivated with combined cultivator-drill early September, and 1st week in October.

This was the first occasion on which a competition of this nature has been conducted in the district. Although the number of competitors was small, a keen interest was taken in the competition.

The winning entry, that of Mr. J. K. Forrester, scored on account of its tilth and depth of mulch, which was reflected in the high moisture content of the subsoil.

The mulch on the second competitor's entry was too fine and level, due to a disc cultivation given at the end of October to kill double-gees.

The seed beds of all the entries were ridged, indicating that the cultivating implements needed adjustment.

It is hoped that next year a larger number of entries will be received, and that competitors or any other interested members of the Agricultural Society will accompany the judge on his tour of inspection.

CONCLUSION.

Generally the standard of the entries in these fallow competitions ranged from good to poor. In the older established districts, adequate plant and power often enables work to be accomplished earlier and better than is possible in newer districts, where farmers have not yet acquired their full equipment. Sheep also play an important part in the production of good fallow. Where sheep were not carried there was usually a noticeable increase in the amount of weed growth. In other cases, attempts to destroy weed growth by cultivation and not by sheep had necessitated working with implements which had interfered with the seedbed and reduced the value of the fallow accordingly. The primary object of fallow competitions is to provide a means of instruction by bringing the farmer into closer touch with the Department of Agriculture.

To produce good fallow a farmer must first realise what is required. His work must be directed towards preparing a suitable compact seedbed and a desirable mulch and the control of weed growth, and all cultivations should be given with these objects in view.

The seedbed should be firm but not hard, and the subsoil should contain the maximum amount of moisture. The seedbed should be comparatively level and uniform, rather than ridged. Such ridging or unevenness may be caused by the use of a disc implement for late cultivation, or by the tynes, pressure springs, etc., of a tyned cultivator being out of adjustment.

Immediately prior to seeding, the mulch should not be deeper than two inches. This necessitates constant attention to the control levers of the implement used for the later cultivations. The mulch should have a reasonably level but somewhat corrugated surface and a fair sprinkling of small clods up to two inches in diameter. Such a mulch assists in preventing the surface soil from setting down hard after subsequent rains followed by dry weather.

M. T. PADBURY TROPHY COMPETITION.

I. THOMAS,

Superintendent of Wheat Farms.

A further year's results are available for the above competition, which has now been conducted for a period of four years, viz., 1930-33 inclusive.

This competition was inaugurated in 1930 as the result of a generous donation made by Mr. M. T. Padbury, a pioneer farmer of the Moora district, and will cover a period of ten years, *i.e.*, the final year will be in 1939.

The trophy is a handsome shield, and each year a replica is made and presented to the winner for that year. This minor trophy was won for the past season by Messrs. F. M. & J. L. Atkins, of Jouerdine, via Lake Brown, who obtained the splendid average of 3 bushels 39 lbs. per inch of rainfall over an area of 376.6 acres.

These farmers were also successful in 1931 with an average yield of 3 bushels 0 lbs. per inch. Last year's figure of 3 bushels 39 lbs. constitutes an official record for this State, the record being previously held by Mr. F. A. Williams, of Mangowine, via Nungarin, with an average of 3 bushels 23 lbs. per inch of growing period rain.

The conditions under which this competition is conducted are as follow:—

1. The competition will commence with the 1930-31 harvest and continue for a period of 10 years. At the end of that period the trophy will be awarded to the competitor who has taken part in the competition for at least five years, and who obtains the greatest mean average acre yield per inch of rainfall during the conventional growing period. The mean average yield will be computed from the results of the five seasons in which the competitor produced the highest acre-yield per inch of rainfall during the growing period. In the event of a tie the competition will continue between the leading competitors until an advantage is gained by one of them.

2. The conventional growing period for any year will be that decided upon and announced by the Royal Agricultural Society. For the first year, and until further notice, it has been decided that it will be from May 1st to October 31st, inclusive.

3. Until the end of the competition the trophy will be in the custody of the Royal Agricultural Society, and will be displayed at any agricultural exhibition held by that society.

4. Each year the competitor who obtains the best average acre yield per inch of rainfall during the conventional growing period will be awarded a replica of the trophy. His name will also be inscribed upon a small shield affixed to the trophy.

5. The rainfall upon which the award will be made will be determined by the Commonwealth Meteorologist from the district records, and his decision in this matter will be final.

6. The competition will be limited to those farmers who harvest at least 200 acres of wheat for grain. Where a competitor is financially interested in the crops grown on one or more farms, he will be required to supply details regarding the production and marketing of the crops on same, and, though usually the award will

be made upon the results from the farm nominated by the competitor, yet the Royal Agricultural Society may require that the crops on these farms be included in the competing area.

7. The average yield will be ascertained from the total area—including self-sown crops—harvested for grain, and determined from the actual amount of wheat sold, as shown by the delivery dockets, plus the amount retained for seed, for home use or for any other purpose.

8. The method of judging will be as follows:—At a convenient time the area harvested for grain will be measured and the quantity of wheat on hand ascertained. On or before January 31st, the farmer will be required to furnish the judge with a sworn declaration as to the quantity of wheat sold from the competing holding or holdings, and the amount retained for seed and other purposes; the statement regarding the amount sold to be supported by agents' dockets. The judge, after satisfying himself as to the correctness of this statement, will compute the average yield per acre per inch of rainfall during the growing period from the information received.

9. The judge will be appointed by the Director of Agriculture, and his decision will be final.

10. Nominations for this competition will be received by the Royal Agricultural Society up to the 31st October each year.

The results for 1933, together with the composite results for the four years the competition has been conducted, are as follow:—

M. T. PADBURY TROPHY COMPETITION.

RESULTS FOR 1933 34.

Competitor.	Address.	Rainfall during Growing Period.	Area Harvested	Yield.		
				Gross.	Average per Acre.	Average per 1in. growing period Rain.
		points.	acres.	bus. lbs.	bus. lbs.	bus. lbs.
Atkins, F. M. & J. L. ...	Jouerdine, *via* Lake Brown	625	376·6	8,580 0	22 47	3 39
Nottage, R. B. ...	Tammin	985	289·7	9,658 16	33 20	3 23
Moore, Hon. T., M.L.C.	Indarra	1,021	251·4	7,906 58	31 27	3 5
Barnett, L. T. C. ...	Walgoolan	879	358·4	9,336 26	26 3	2 58
Glengarry Estate ...	Gnowangerup ...	1,158	203·0	6,865 54	33 49	2 55
Snell, C. & Son ...	Nangeenan ...	917	201·0	5,356 31	26 39	2 54
Perkins, C. C. ...	Belka	911	460·3	11,890 3	25 50	2 50
Horsman, H. & Sons...	Bilbarin	932	295·0	7,725 30	26 11	2 49
Strange, P. A. ...	Yarding	842	351·0	8,255 42	23 31	2 48
White, R. H.	Gnowangerup ...	1,158	336·0	10,394 48	30 56	2 40
Breimer, J. R. & Sons	Corrigin	873	940·0	20,776 13	22 6	2 32
Reichelt, E. E. ...	Burracoppin ...	939	639·0	15,100 0	23 38	2 31
Harris, E. G. S. ...	Mukinbudin ...	753	378·0	6,340 48	16 46	2 27
Small & King ...	Shackleton	892	304·0	6,646 12	21 52	2 27
Allen Bros.	Kunminin	932	636·0	14,468 46	22 45	2 26
Rudduck, S. A. ...	Coorow	1,197	571·0	15,651 59	27 25	2 17
Creagh Bros.	Nungarin	807	921·0	16,302 13	17 42	2 12
Hughes, J. R. ...	Minnivale	1,051	363·0	8,423 54	23 12	2 12
Scadding, N. A. ...	Kulin	1,131	451·7	1,1094 51	24 34	2 10
Manuel, C. J.	Mukinbudin ...	753	345·0	5,408 31	15 41	2 5
Anderson Bros. ...	Dowerin	1,040	450·7	9,681 13	21 29	2 4
Stevens, G. K. ...	South Ghooli ...	859	271·9	4,822 12	17 44	2 4
Kingston, D. W. ...	Boodarockin ...	717	427·0	6,182 55	14 29	2 1
Nixon & Sons ...	Kalannie	1,166	3,040·0	64,560 0	21 14	1 49
Haggerty, H. J. ...	Yarding	*	308·0	7,386 45	23 59	...
Butcher, O. J. ...	Pithara	*	...	...	...	...

* Details not yet complete.

M. T. PADBURY TROPHY RESULTS—1930-33 (INCLUSIVE).

Competitor.	Address.	Average Yield per Acre per Inch of Growing Period Rain.			
		1930.	1931.	1932.	1933.
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lb.
Allen Bros.	Central Kumminin ...	2 11	2 23	...	2 26
Anderson Bros.	Dowerin	...	...	...	2 4
Atkins, F. M. & J. L. ...	Jouerdine	2 41	3 0	...	3 39
Barnett, L. T. C. ...	Walgoolan	2 48	2 19	2 34	2 58
Barr, D. F.	Shackleton	1 49	...	...	...
Beeck, H. O.	Gnowangerup	...	2 10	...	...
Bishop, H. F.	Lake Grace	2 1	...	1 59	...
Bothe, B. D.	Coorow	...	2 2	...	...
Bremner, J. R. & Sons ...	Corrigin	1 55	2 10	1 48	2 32
Butcher, O. J.	Pithara	...	...	2 42	...
Carter, H. R.	Three Springs	1 55	1 8	...	...
Carter, J. S. & S. T. ...	Benjaberring	1 41	1 19	...	...
Clarke, R. W.	Carnamah	1 22	...	...	...
Cowan, C. W.	East Narembeen ...	1 28	...	...	...
Craigie, J.	Yarding	2 28	...	...	...
Creagh Bros.	Nungarin	2 20	2 16	1 43	2 12
Cuming, A. S.	Carnamah	...	1 57	...	...
Cusbert, L. C.	Bruce Rock	2 44	1 58	...	...
Evans, L. D.	Nukarni	...	...	2 21	...
Finklestein H. ...	Shackleton	...	1 55	...	...
Garnett, J.	Gnowangerup	...	2 5	...	...
Garrett, G.	Ardath	1 38	...	...	...
Gilham, F.	Bencubbin	2 28	...	...	...
Glengarry Estate ...	Gnowangerup	1 52	2 37	1 54	2 55
Haggerty, H. J. ...	Erikin	2 51	...	...	...
Hammond, J. D. ...	Kellerberrin	2 26	...	...	...
Harris, E. G. S. ...	Mukinbudin	...	2 24	...	2 27
Henderson, Late J. H. ...	Gnarming	2 21	...	...	...
Horsman, H. & Sons ...	Bilbarin	1 53	2 6	1 5	2 49
Hughes, J. R.	Minnivale	...	...	...	2 12
Jacob, H. D.	Erikin	2 9	...	...	...
Kingston, D. W. ...	Boodarockin	...	1 46	...	2 1
Leah, J. & Sons ...	Ardath	2 45	2 26	...	...
Lohoar, W.	Borden	2 16	...	...	...
Manuel, C. J.	Mukinbudin	2 44	2 10	2 5	2 5
McLennan Estate ...	Borden	...	...	1 55	...
Moore, T., Hon. ...	Indarra	...	2 47	2 33	3 5
Morcombe, P. T. ...	Waddy Forrest	2 4	...	1 48	...
Nixon & Sons	Kalannie	1 57	...	...	1 49
Nottage, R. B.	Tammin	...	2 36	2 21	3 23
Perkins, C. C.	Belka	...	...	...	2 50
Pascoe Bros.	Yalbarrin	3 14	...	...	...
Prowse, E. W.	Doodlakine	1 42	...	1 31	...
Reichelt, E. E.	Burracoppin	...	...	...	2 31
Reichelt, F. W. ...	North Burracoppin ...	2 8	...	...	...
Richards, A.	South Caroling	...	...	1 9	...
Richardson Bros. ...	Bonnie Rock	...	1 33	1 27	...
Riches, H. & Sons ...	Wyalkatchem	...	1 56	...	...
Rudduck, S. A.	Coorow	...	...	...	2 17
Scadding, N. A. ...	Kulin	...	...	2 4	2 10
Small & King	Shackleton	...	...	...	2 27
Smith, C. & A. H. ...	Yalbarrin	2 38	2 1	...	...
Smith, C. & Sons ...	Yarding	2 21	2 29	...	...
Snell, C. & Sons ...	Nangeenan	2 29	...	...	2 54
Stevens, G. K.	Ghooli	...	2 19	...	2 4
Stevenson, K. J. O. ...	Watheroo	1 16	...	...	...
Stewart, T. D.	Gnowangerup	1 28	...	...	...
Strange, P. A.	Yarding	2 36	2 6	...	2 48
Tibbs, J. A.	Bruce Rock	2 25	...	...	...
White, R. H.	Gnowangerup	1 51	2 45	...	2 40
Williams, F. A. ...	Mangowine	3 23	2 25	1 34	

MAIZE FERTILISER TRIALS, 1933-34

H. G. Elliott, Agricultural Adviser, Dairy Branch.

The maize fertiliser trials were continued during the season 1933-34 and were carried out throughout the South-West. The cost was borne jointly by Cuming, Smith & Mt. Lyell Farmers' Fertilisers Ltd. and the Department of Agriculture.

The object of the experiments was to ascertain if results would be obtained similar to those of last season regarding the most economical fertilisers to use for the growing of maize, the soils chosen in each case being those representative of the district.

The fertilisers used and rates per acre were:—

1. Superphosphate 4 cwts. Control.
2. Superphosphate 4 cwt., + sulphate of ammonia 2 cwt.
3. Superphosphate 4 cwt., + sulphate of ammonia 2 cwt., + sulphate of potash 1 cwt.
4. Superphosphate 4 cwt., + sulphate of potash 1 cwt.

Lay-out of Plots.—Each plot was of one-eighth acre and each treatment replicated three times for accuracy, taking into consideration any variation in soil conditions.

MESSRS. BEE BROS., KEYSBROOK.

The trial on the property of Messrs. Bee Bros. was supervised by Agricultural Adviser H. G. Elliott.

Soil.—The type selected was a brown sandy loam overlying clay. This was old "subterranean clover" land originally carrying red gum and jarrah.

Cultivation.—The soil was prepared by spring ploughing and harrowing, the land being re-worked and ploughed prior to planting.

Method of Sowing.—The fertiliser was applied to every third furrow and lightly covered with soil prior to sowing the seed.

Germination.—Good.

Depth of Seeding.—Approximately 2½ to 3 inches.

Rate of Seeding.—30 lb. per acre.

Variety.—"Hickory King."

Distance between Rows.—30 inches.

Weights taken on 2nd February, 1934.

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER—BEE BROS., KEYSBROOK. SEASON 1934.

On Old Clover Land. Planted 1st November, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre plus Freight.	Average Yield per acre.	Worth of Yield per acre at 15/- per ton.	Worth of Crop per acre less Fertiliser Cost and Freight.	Percentage Yield.
		£ s. d.	Tons.	£ s. d.	£ s. d.	%
1, 5, 9 (Controls)	Superphosphate ... 4 cwt.	0 19 6	6·920	5 3 10	4 14 4	100
2, 6, 10 ...	Superphosphate ... 4 ,, Sulphate of ammonia 2 ,,	2 5 11	9·480	7 2 2	4 16 3	137
3, 7, 11 ...	Superphosphate ... 4 ,, Sulphate of amomnia 2 ,, Sulphate of potash ... 1 ,,	3 6 5	7·932	5 19 0	2 12 7	114
4 8, 12 ...	Superphosphate ... 4 ,, Sulphate of potash ... 1 ,,	1 19 8	8·246	6 3 8	4 4 0	119

Note.—Fertiliser freight—North Fremantle to Keysbrook—7½d. per cwt. Super at £4 5s. per ton; sulphate of ammonia at £12 12s. per ton; sulphate of potash at £19 11s. 6d. per ton.

L. STILES, GROUP 52, VASSE.

This trial was supervised by Dairy Instructor C. Giles.

Soil.—Varying from a light sandy to red clay loam originally carrying red gum and jarrah, old "subterranean clover" land.

Date of Seeding.—8th November, 1933.

Rows.—27 inches apart.

Rate of Seeding.—20 lb. per acre.

Variety.—"Hickory King."

Method of Planting.—Drills ploughed 4 inches deep, and 36 inches apart. Fertiliser lightly covered prior to seeding.

Weights taken on 9th February, 1934.

Germination.—Generally good but failed in light sand, growth uneven.

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER—L. STILES, VASSE.

SEASON 1934.

On Land previously growing Sub. Clover. Planted 8th November, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre plus Freight.	Average Yield per acre.	Worth of Yield per acre at 15/- per ton.	Worth of Crop per acre less Fertiliser Cost and Freight.	Percentage Yield.
		£ s. d.	Tons.	£ s. d.	£ s. d.	%
1, 5, 9 (Controls)	Superphosphate ... 4 cwt.	0 19 6	6·893	5 3 5	4 3 11	100
2, 6, 10 ...	Superphosphate ... 4 ,, Sulphate of ammonia 2 ,,	2 5 11	9·252	6 18 9	4 12 10	136
3, 7, 11 ...	Superphosphate ... 4 ,, Sulphate of ammonia 2 ,, Sulphate of potash ... 1 ,,	3 6 5	10·205	7 10 3	4 4 10	148
4, 8, 12 ...	Superphosphate ... 4 ,, Sulphate of potash ... 1 ,,	1 19 8	8·231	6 3 5	4 3 9	119

Note.—Fertiliser freight—Picton to Vasse Siding—7½d. per cwt. Superphosphate £4 5s. per ton; sulphate of ammonia £12 12s. per ton; sulphate of potash £19 11s. 6d. per ton.

A. J. KEMP, RUABON.

The trial was supervised by Dairy Instructor C. Giles.

Soil.—Grey sandy loam, new land, originally timbered with red gum, banksia, and jarrah.

Preparation of Land.—Ploughed 8 inches deep in autumn and left open until late spring, then cultivated and reploughed.

Rate of Seeding.—28 lb. per acre.

Variety.—"Hickory King."

Date of Seeding.—15th to 18th November, 1933.

Width of Rows.—27 inches apart.

Weights taken on 20th February, 1934.

General.—Owing to the drought conditions, the experiment was a virtual failure, and 50 per cent. of the plants died off after germination.

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER—A. J. KEMP, RUABON.

SEASON 1934.

On New Land. Planted 15th November, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre plus Freight.	Average Yield per acre.	Worth of Yield per acre at 15/- per ton.	Worth of Crop per acre less Fertiliser Cost and Freight.	Percentage Yield.
		£ s. d.	Tons.	£ s. d.	£ s. d.	%
1, 5, 9 (Controls)	Superphosphate ... 4 cwt.	0 19 0	4·1135	3 1 8	2 2 8	100
2, 6, 10 ...	Superphosphate ... 4 ,, Sulphate of ammonia 2 ,,	2 5 2	4·3960	3 6 0	1 1 0	170
3, 7, 11 ...	Superphosphate ... 4 ,, Sulphate of ammonia 2 ,, Sulphate of potash ... 1 ,,	3 5 3	5·2010	3 18 0	0 12 9	126
4, 8, 12 ...	Superphosphate ... 4 ,, Sulphate of potash ... 1 ,,	1 19 1	2·2042	1 13 7	0 5 6 (Loss)	53

Note.—Fertiliser freight—Picton to Wonnerup—6d. per cwt. Super at £4 5s. per ton; sulphate of ammonia at £12 12s. per ton; sulphate of potash at £19 11s. 6d. per ton.

R. BURKE, KALGUP.

The trial was supervised by Dairy Instructor C. Giles.

Soil.—Grey sandy loam over clay, originally timbered with jarrah and red gum, old "Subterranean" and "Drooping Flowered Clover" land.

Drainage.—Insufficient.

Date of Sowing.—11th and 12th December, 1933.

Width of Rows.—30 inches apart.

Weights taken on 26th February, 1934.

General.—Birds did a lot of damage. Drought also greatly affected yields. Growth uneven, varying from 3 to 9 feet.

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER—R. BURKE, KALGUP.

SEASON 1934.

On Land previously growing Sub. and Drooping Clover. Planted 11th December, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre plus Freight.	Average Yield per acre.	Worth of Yield per acre at 15s. per ton.	Worth of Crop per acre less Fertiliser Cost and Freight.	Percentage Yield.
		£ s. d.	Tons.	£ s. d.	£ s. d.	
1, 5, 9 (Controls)	Superphosphate ... 4 cwt.	0 19 0	6·7110	5 0 8	4 1 8	100
2, 6, 10 ...	Superphosphate ... 4 ,, Sulphate of Ammonia 2 ,,	2 5 2	8·1938	6 2 10	3 17 8	122
3, 7, 11 ...	Superphosphate ... 4 ,, Sulphate of Ammonia 2 ,, Sulphate of Potash ... 1 ,,	3 5 3	9·2200	6 18 4	3 13 1	137
4, 8, 12 ...	Superphosphate ... 4 ,, Sulphate of Potash ... 1 ,,	1 19 1	7·9680	5 19 6	4 0 5	119

Note.—Fertiliser freight—Picton to Wonnerup—6d. per cwt. Super at £4 5s. per ton; sulphate ammonia at £12 12s. per ton; sulphate potash at £19 11s. 6d. per ton.

W. E. WHITE, WOKALUP.

The trial was supervised by Agricultural Adviser H. G. Elliott.

Soil.—Red to yellow clayey loam, old "Subterranean Clover" land.

Drainage.—Fair.

Preparation.—Ploughed at end of October, harrowed and twice cultivated prior to planting.

Date Planted.—Commenced 26th December, 1933.

Variety.—"Hickory King."

Rate of Seeding.—60 lb. per acre.

Germination.—Very erratic, owing to poor weevil eaten seed, about 50 per cent.

Weight taken on 26th March, 1934.

General.—Crop very uneven in growth, but was in cobbing stage at time of judging.

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER—SEASON 1934.

W. E. WHITE, WOKALUP.

On land previously growing Subterranean Clover. Planted 26th December, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre, plus Freight.	Average Yield per acre.	Worth of Yield per acre at 15/- per ton.	Worth of Crop per acres, less Cost Fertiliser and Freight.	Percentage Yield.
		£ s. d.	tons.	£ s. d.	£ s. d.	
1 5, 9 (Control)	Superphosphate ... 4 cwt.	0 19 8	8·49	6 7 4	5 7 8	100
2, 6, 10 ...	Superphosphate ... 4 ,, Sulphate of Ammonia 2 ,,	2 6 3	8·917	6 13 9	4 7 6	105
3, 7, 11 ...	Superphosphate ... 4 ,, Sulphate of Ammonia 2 ,, Sulphate of Potash 1 ,,	3 6 6	9·530	7 2 1	3 15 7	112
4, 8, 12 ...	Superphosphate ... 4 ,, Sulphate of Potash 1 ,,	1 19 11	9·190	6 17 10	4 17 11	108

Note.—Fertiliser freight—Fremantle to Wokalup—8d. per cwt. Superphosphate at £4 5s. per ton; sulphate of ammonia at £12 12s. per ton; sulphate of potash at £19 11s. 6d. per ton.

A. L. STAER, FOREST GROVE.

The trial was supervised by J. H. Nelson, Dairy Supervisor.

Soil.—Varying from a grey sandy loam to light gravel.

Cultivation.—Ploughed on 8th and 9th September, 1933, spring-tyne cultivated on October 21st, and harrowed on October 29th.

Variety.—"Hickory King."

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER.

A. L. STAER, FOREST GROVE.

Planted 30th October, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre, plus Freight.	Average Yield per acre.	Worth of Yield per acre at 15/- per ton.	Worth of Crop per acres, less Cost Fertiliser and Freight.	Percentage Yield.
		£ s. d.	Tons.	£ s. d.	£ s. d.	
1, 5, 9 (Control)	Superphosphate ... 4 cwt.	0 19 4	6·040	4 10 7	3 11 3	100
2, 6, 10 ...	Superphosphate ... 4 ,, Sulphate of Ammonia 2 ,,	2 5 9	6·291	4 13 3	2 7 6	104
3, 7, 11 ...	Superphosphate ... 4 ,, Sulphate of Ammonia 2 ,, Sulphate of Potash 1 ,,	3 5 11	7·650	5 14 9	2 8 10	127
4, 8, 12 ...	Superphosphate ... 4 ,, Sulphate of Potash 1 ,,	1 19 6	8·612	6 9 2	4 9 8	143

Note.—Freight on fertiliser—Picton to Forest Grove—7d. per cwt. Superphosphate at £4 5s. per ton; sulphate of ammonia at £12 12s. per ton; sulphate of potash at £19 11s. 6d. per ton.

The following table gives the average for the season 1934, and for the two seasons 1933 and 1934:—

Fertiliser per Acre.	Cost of Fertiliser and Freight.		Average Yield.		Worth of Yield per Acre at 15s. per ton.		Worth of Crop per Acre, less Cost Fertiliser and Freight.		Percentage Yield.	
	1934.	1933 and 1934.	1934.	1933 and 1934.	1934.	1933 and 1934.	1934.	1933 and 1934.	1934.	1933 and 1934.
	£ s. d.	£ s. d.	tons.	tons.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		
1. Super. (Control) 4cwt.	0 19 4	0 19 10	6·528	7·165	4 17 11	5 7 6	3 18 7	4 7 8	100	100
2. Super. 4 cwt. Sulph. Ammonia 2 cwt.	2 5 8	2 6 2	7·755	10·041	5 16 1	7 10 6	3 10 5	5 4 4	119	140
3. Super. 4 cwt. Sulphate Ammonia 2 cwt. Sulphate Potash 1 cwt.	3 2 7	3 5 5	8·29	10·414	6 3 9	7 16 1	3 1 1	4 10 8	127	145
4. Super. 4 cwt. Sulphate Potash 1 cwt.	1 19 6	2 0 8	7·409	8·311	5 9 6	6 8 11	3 10 0	4 8 3	115	116

Note.—During 1933-34 season, the summer generally was quite unfavourable to heavy yields, owing to extreme dryness, and early in the period high winds from the east, which had a very detrimental effect on growth.

A MODIFIED ROTATION FOR THE WHEAT BELT.

* T. C. DUNNE, Muresk Agricultural College,
and
† F. L. SHIER, Department of Agriculture.

The developmental stage of farming areas is usually characterised by a number of years of continual cropping to the most profitable product. The reason for this is the necessity for obtaining maximum production from a limited area while development is proceeding. Within a few years there becomes evident a decrease in yield and a change is made either by sowing a different crop or by giving the land a period of rest. This is the beginning of a regular system in farming practice, worked out to suit the conditions, which is known as a rotation.

The purpose of a rotation is the maintenance or improvement of fertility and production. The suitability of any rotation for an area will be judged by the degree to which these aims are achieved. The rotation may be of such a nature that one particular crop is of major importance and value with the intermediate crops occupying a definitely minor position. Alternatively, all the different crops may be considered of equal importance when the aim is to maintain productivity in all lines.

It is evident that in any area the suitable rotation will be conditioned by a number of factors which will include climate, soil, nutritive requirements of different crops, manure costs, stock feeding, markets, plant diseases, insect pests and distribution of labour. Further modification may be necessary to cope with more local conditions.

Rotation in Western Australia.

In the wheat areas of this State, farming generally began with continuous cropping. The question of moisture supply was early recognised as of importance and the alternation of crop and bare fallow was very soon adopted. Even under these conditions however, there was a decrease in the yield of crops so that the land was left out of crop for a further year as a resting period. This year served somewhat as a restorative. The advent of sheep into many areas made it necessary to use this resting year as a pasture and thus the present system of fallow, wheat, pasture was developed. This rotation is in fairly general use in the areas in which wheat predominates and in many of the wheat and sheep areas.

The fallow, wheat, pasture rotation was certainly an improvement over the fallow wheat system, and it was considered that this rotation would maintain the fertility and production of the soil. Within recent years, however, it has been realised that in many cases fertility is not being maintained and that production is on the decrease or is not at the level expected. It is probable that in some areas this decrease in fertility has been occurring for many years but that its effect has been masked by the introduction of new prolific varieties of wheat and the dissemination of better methods of farming, which made for higher yields over a period of years.

Deficiencies of Three-Year Rotation.

A study of the three-year rotation (fallow, wheat, pasture) reveals several deficiencies.

* Merchants' Research Officer in Agrostology.
† Agricultural Adviser, Department of Agriculture.

Fallow is undoubtedly a very important part of any system of farming in this State if only for its part in the conservation of moisture. Its benefits, however, are attributable also to a number of other factors which include the destruction of weeds, the building up of soluble nitrogen, increase in available plant nutrients, aeration of the soil, etc. However, it should be remembered that fallow actually adds practically nothing to the soil except perhaps some nitrogen from the atmosphere and the degree to which this is done is directly dependent on the organic matter already existing in the soil. As against this, fallow provides ideal conditions for the rapid decomposition of organic matter and very large quantities are used up in this manner. What fallow actually achieves in connection with plant nutrients is to place these substances at the disposal of the plant in a much more readily available form than would otherwise be the case. In heavy rainfall areas this may even be disadvantageous as soluble nitrogen compounds (nitrates) are very easily leached and with the early heavy winter rains may be washed out of reach of the plants.

A good yielding wheat crop must of necessity be very exhausting. With the conservation of moisture and destruction of weeds of a well worked fallow, and the prolific varieties of wheat now available, the wheat crop is assured providing the level of general fertility in the soil has been maintained reasonably well.

The third or pasture year is undoubtedly the weak portion of the rotation. Providing the destruction of weeds for the wheat crop has been done satisfactorily, the year following provides very little growth and the term pasture is in most cases a misnomer—it is really a stubble period. In such cases the cover will depend on three main sources for introduction. Hard seeds of clover and other annuals which have lain dormant may germinate and, with topdressing, may develop into a reasonably good stand. In some districts and in some soils this gives a fairly satisfactory first year pasture. Apart from this, seeds may be carried into the field by sheep feeding on the stubble or may be blown from neighbouring paddocks. These methods cannot be depended upon for the securing of a good pasture and it is therefore, evident that it cannot be expected that weed free crop will be followed by a good pasture year. Too frequently the so-called pastures consist of a number of stunted plants of cape weed and barley grass which produce very little feed.

With such poor growth, very little organic matter is returned to the soil. The main restoration of this substance is achieved by the return to the soil of the stubble and of plant roots which are left after the removal of the crop. In view of the rapid decomposition of organic matter under fallow conditions the amount returned in this way is not enough for maintenance of this important factor in soil fertility.

Apart from the aspect of maintaining fertility for cropping, the feeding of sheep must be considered. Sheep have become an important part of farming in many areas and will undoubtedly become still more important. They act as useful allies in controlling weeds on fallow and provide a means for the utilisation of stubble. The value of good pasture in the economy of sheep farming can hardly be over-estimated. A good pasture should not only achieve more efficient utilisation of stubble but should serve as a means of conservation for the feeding of sheep during the dry summer months.

The three year rotation is then deficient, mainly through the failure of the pasture year to provide sufficient bulk for the maintenance of adequate soil organic matter or the feeding of any large number of sheep. It is necessary, therefore, to provide for a pasture period which will ensure sufficient growth for the feeding of stock and the renovation of the soil.

A further disadvantage is that barley grass, which is often an important constituent of the pasture under the three-year system, acts as alternate host for take-all and thus allows for its being carried over to the succeeding crop.

Crop Rotation in England.

In the earliest times continuous cultivation and cropping of a piece of land was practised in England. When it was exhausted, another piece was selected until it also became unproductive. Under the manorial system, however, regular rotations on the village farms were enforced. The most common rotation was probably *winter corn, spring corn* and *fallow,* which enabled the land to be kept fairly clean for a number of years. There was little change until about the middle of the eighteenth century.

About this time roots and red clover were introduced into farming practice and became a part of the Norfolk four-course rotation. This rotation has proved of such value that in many parts of England it still persists unchanged. Furthermore, investigations at Rothamsted have shown that it is well balanced and the fertility of the land is maintained without large expenditure for manures. In view of the fact that it was designed for the production of good crops of wheat on relatively light soils and that it has proven so successful, some features of it are of especial interest to the discussion.

The system of cropping is—*roots, spring cereal* (*barley*), *clover, winter cereal* (*wheat*). This system embodies the main principles on which all rotations are based. Roots which must be kept free from weeds act as a cleaning crop, spring cereal aids in the distribution of labour throughout the year, and red clover provides a renovating crop. All these factors tend to assure heavy production of the main winter cereal crop of wheat.

While this particular rotation does not apply to the conditions of our wheat areas, the same principles do apply and these can be adapted to suit the peculiarities of climate and soil.

Perhaps the most outstanding feature of the rotation from the viewpoint of farming in this State, is the relatively large amount of organic matter returned to the soil. Roots and clover are fed to stock on the farm and the straw from cereals either consumed or trodden into manure by the stock. Thus every crop provides its quota of organic matter to replace that broken down during the period of rotation. Another feature is the growing of four different crops in order that advantage may be taken of their different nutritive requirements. A third feature is the inclusion of a leguminous crop which will stimulate considerably the activity of bacteria and fungi in the soil.

Modification of Three-Year System in Western Australia.

The application of the principles of the English rotation makes it clear that improvement is needed in the amount of organic matter returned to the soil. This can best be done by a good pasture, and a leguminous pasture should be most suitable.

Under the three-year system, however, a good pasture is hard to obtain. To obtain a good stand of clover in one year would necessitate a very heavy rate of seeding which would in most cases be unprofitable. On the other hand, relatively light sowings of clover will give good stands in two or three years providing annual topdressing with superphosphate is practised. Apart from the question of soil improvement, clover is under our conditions the best pasture from many viewpoints. It is more or less obvious, therefore, that the first step in strengthening the rota-

tion is the improvement of the pasture period by the use of clover and by allowing the pasture to remain as such for a period of years.

The number of years of continuous pasture will depend on several factors. With a light sowing many clover pastures enter the period of best productivity about the third year and will remain productive for some years. There is, however, a tendency towards a natural cycle of legumes and grasses (including cereals). On an impoverished soil, clover will spread rapidly and become dominant within a short time. A few years of good clover, however, build up the soil fertility to such an extent that conditions are made more suitable for grasses which are enabled to compete successfully with the clovers. The clover will be observed to be going back and the grasses improving. This indicates the ideal stage for breaking up the pasture and cropping the cereals in order that they may derive the benefit of the increased fertility. In general, however, the minimum period for clover pasture will be three or four years and the maximum six or seven years.

With the lengthening of the pasture period to four years and no other change in the rotation, good crops would probably be secured by a rotation consisting of bare fallow, wheat, four year pasture, but this would give only one-sixth of the area under crop each year. This proportion of crop is too low for the usual wheat farming conditions. However, farming practice in the early stages of development showed that when the fertility of the soil was reasonably high, alternate fallow and crop would produce good yields for a period of years.

A rotation embodying the points discussed above is suggested as an improvement in the direction of better maintenance of fertility and yields. No definite rotation can be laid down which will suit all needs in all areas, but rather are the principles to be followed and adapted to suit individual requirements. *The rotation suggested consists of continuous clover pasture for several years followed by alternate fallow and crop for a further period of years.*

The experimental fallow versus non-fallow plots at Chapman State Farm sown under the three year system, have averaged over the period 1929-32, 16 bushels 27 lbs. and 15 bushels per acre respectively. When, in 1933, these plots were transferred to an area of similar soil which had been under pasture since 1927, the respective yields were 28 bushels 21 lbs. and 32 bushels 5 lbs. per acre. The average yield from all these latter plots was 30 bushels 13 lbs. per acre, which is considerably higher than has previously been obtained from this paddock or from any similar soil on this farm. This improvement can only be attributed to the beneficial effect of the pasture period.

Heavier Rainfall Areas—Over 16 *inches per annum.*

The pasture in these areas should be early subterranean clover. Good growth will usually be obtained for at least five years, the last three years being the most productive. With the higher rainfall, fallow is not as essential for conservation of moisture as in the drier districts. Moreover, after a long pasture period the soil nitrogen content should be high, so that for the first cropping following pasture, fallow may be omitted, the land being cropped immediately after ploughing. The two succeeding crops should preferably be sown after fallow.

The rotation for each paddock would be *five years pasture, crop, fallow, crop, fallow, crop,* and the subdivision of the farm—

Pasture.	Crop.	Fallow.	Total area.
500	300	200	1,000

This division assumes units of 100-acre paddocks in order that each year one paddock is changed from crop to pasture and one paddock from pasture to crop.

In some of the higher rainfall areas, oats are often sown directly after wheat on fallow. To include this practice the rotation could be modified to *five years pasture, crop, fallow, crop* (*wheat*), *crop* (*oats*).

Again, where sheep raising is more important than cropping, the rotation may be made shorter to fill this need for a smaller proportion under crop. Such a system may be *five years pasture, crop, fallow, crop,* giving the division—

Pasture.	Crop.	Fallow.	Total area.
500	200	100	800

It will be realised, of course, that in such areas it may be advantageous to lengthen the period of pasture. In this case, of course, the proportion under crop would be decreased. As an example, a seven year pasture period followed by crop, fallow, crop, would give only one-fifth cropping, the proportions being—

Pasture.	Crop.	Fallow.	Total area.
700	200	100	1,000

Alternation of wheat and oats in the cropping is desirable and in the cases where the larger amount of cropping is done, this practice should be followed. The alternation of cereals is not as exhausting as cropping wholly to wheat, advantage being taken of the differing nutritive requirements of the crops. Furthermore, considerable good may be done in the control of plant diseases.

With the advantage of the cleaner fallows and crops which should be procured under this system, it may be possible to substitute a crop of peas for a fallow. This, of course, will apply mainly in the higher rainfall areas and will be dependent on the amount of labour available.

Subterranean Clover.

In the rainfall areas above 16 inches per annum, early sub-clover should be the main legume and pasture constituent—in fact these areas are considered to constitute the early sub-clover belt. A few comments on this clover are deemed advisable.

At present four main strains of subterranean clover are recognised. Tabulated in order of earliness of maturity, they are as follow—

1. Dwalganup or First early strain.
2. Daliak or Second early strain.
3. Midseason strain.
4. Brunswick or Late strain.

The various strains of sub-clover are described and discussed in Leaflet No. 225 of the Department of Agriculture.

It must be emphasised that there is just as much difference and importance in the period required for maturity of the different strains of sub-clover as there is between the different varieties of wheat.

The main varieties on the market at present are First early strain and Midseason strain. The former flowers and matures seed about one month earlier than the latter. Except where the rainfall approximates 25 inches per annum, Midseason sub-clover has practically no possibility of success. Where superphosphate has been applied the failure of most farmers to succeed with sub-clover can be attributed to to the use of the wrong variety. First early sub-clover has been grown successfully at Muresk Agricultural College (rainfall 17 inches per annum) for about seven years and by distributing burr from the original area sown, has been established over a considerable portion of the farm. Only isolated plants of the Midseason strain have persisted in the wetter patches. It cannot be emphasised too much that

farmers in the areas under review intending to sow sub-clover should insist on the First early (Dwalganup) strain.

Eggs of insect pests of sub-clover, clover springtail (lucerne flea) and red-legged earth mite, are readily distributed on clover burr. Where the clover is being sown, therefore, care should be taken to procure cleaned seed and not burr in order to avoid the introduction of these pests.

It should also be emphasised that topdressing with superphosphate is essential to success.

Lighter Rainfall Areas—Below 16 inches per annum.

While experience may show that first early sub-clover will grow successfully in some areas with less rainfall than 16 inches per annum, it is probable that burr trefoil or cluster clover will be the main pasture constituents. Burr trefoil is capable of excellent growth, particularly on the heavier soils. However, its spiny seed burrs which become attached to the wool are a disadvantage. Cluster clover, normally, does not produce the same bulk of feed, but is better suited than burr trefoil to the lighter soils.

In the lighter rainfall areas, cropping is usually more important than sheep raising. For this reason a suitable rotation must allow for a fair proportion of the land under crop each year. Further, fallow is essential for the conservation of sufficient moisture for the production of good cereal yields in these areas.

The basic rotation suggested is *four years pasture, fallow, crop, fallow, crop, fallow crop,* giving the proportions—

Pasture.	Fallow.	Crop.	Total area.
400	300	300	1,000

Modifications of the nature previously discussed may, of course, be necessary to meet the requirements of individual farmers or of differing soils.

How to Begin the Rotation.

It is not possible to change over immediately from one system of farming to another. It should be realised that in the rotation suggested above, the pasture is being treated more or less as a crop, which means that a change is being made to a more intensive system of farming. The change must be made gradually but the introduction of two major features new to some areas will be necessary.

1. *Subdivision.*

The scheme outlined above assumes units of 100-acre paddocks. This is necessary for the even production of both crop and pasture. On this assumption each year 100 acres is changed over from crop to pasture and 100 acres of old pasture is put into cropping. The effect of this will be to have areas under crop in different stages of the rotation, namely one under its first crop, one under its second crop and one under its third crop of the rotation. With the pasture, one paddock has first year pasture, one second year pasture, one third year pasture and so on.

While the subdivision may be considered a disadvantage for cropping, experiments have shown that better results are secured by grazing paddocks in rotation. If the area is fed off rapidly and the stock moved more often, the pasture has ample time to recuperate and selective grazing by the stock is reduced to a minimum. From this point of view it may later be found that further subdivision is advantageous.

2. *Topdressing with Superphosphate.*

The rotation aims to include clover as the dominant pasture constituent. For good growth and spreading of clover, topdressing with superphosphate is essential. It will, therefore, be necessary to super. the pasture every year at the rate of 50-100

lbs. per acre to obtain maximum returns. This will be amply repaid by the increased sheep carrying capacity of the pasture apart from a lessening of nutritional diseases with the stock.

With these points in mind a beginning can be made. The paddock most run down should be first put to clover pasture. This is best done by broadcasting clover seed with the final crop. This crop may be cut for hay or harvested for grain and the clover will form seed underneath.

The rate of seeding will be about 2 lbs. of cleaned seed free from burr per acre for sub-clover and about 1 lb. per acre for burr trefoil and cluster clover. If not sown with the crop, the clover seed should be broadcast the following year with the advent of the first winter rains. The next year another area will be sown in a similar manner. As more pasture is sown it will be necessary to change the best of the remaining paddocks over to alternate bare fallow and crop in order to maintain the area under crop. Depending on the period adopted for pasture, at the end of four or five years the pasture paddocks will be changed to alternate fallow and crop and the rotation is under way.

After a few years it should be possible to collect enough seed in burrs from the older-established pastures by raking during the summe for the sowing of the new pastures. As early sub-clover buries its seed, it will be necessary to cultivate before raking, in order to bring the seed to the surface. As far as is possible, burr should be collected from paddocks free from insect pests of clover, as the eggs of these are often attached to the burrs and so become distributed.

Benefits of the Rotation.

The rotation as outlined above will retain all the desirable effects of fallow and will allow of the maximum benefit from this practice. Experience from the rotation experiment at Merredin Experiment Farm shows that weeds will be particularly well controlled by the alternate fallow and crop with considerably less cultivation than was the case under the three-year system.

Clover springtail and red legged earth mite have become, in many districts, serious pests of clover. The more effective control of weeds will limit the hosts for these pests during the cropping period and the following pasture should be relatively free from trouble of this nature in the early years, providing clean seed is sown.

The pasture years under clover will act as a useful buffer between cropping periods and will for this reason help control plant diseases attacking wheat. In addition, the large amounts of organic matter returned to the soil during these years will tend towards increased yields in the following crops. Soil fertility is to a great extent dependent on the bacterial activity of the soil and this may be greatly increased by the addition of organic matter, particularly that of high nitrogen content. The organic matter returned from a clover pasture, whether obtained from grazing sheep or the residual clover roots, is rich in nitrogen. Furthermore, organic matter makes the soils more friable and more easily worked.

Summary and Conclusion.

A modification of mixed farming management in wheat and sheep areas is discussed and a system of rotation is outlined which will involve more intensive farming and better control of many of the difficulties in wheat farming. The system advocated takes advantage of the benefits of the fallow-wheat rotation in controlling weeds and diseases and economy of cultivation, and ensures a maximum production of pasture of high feeding value.

A scheme is proposed for the layout of a mixed farming proposition to take advantage of the modified system.

ROTATIONAL GRAZING TRIALS.

Season 1933-1934.

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and
H. G. ELLIOTT, Agricultural Adviser (Dairy Branch).

During the last three years considerable attention has been paid to the possible value of rotational grazing in Western Australia in raising the stock-carrying capacity of our pasture lands. As far as this State is concerned, the limiting factors have proved to be three-fold—

1. The uneven distribution of the annual rainfall;
2. The general infertility of soils from the pasture point of view;
3. The botanical composition of existent pastures, which are mainly leguminous.

The first point is shown in the following Table (1) giving the average monthly rainfall for the eight centres where these trials have been conducted, and also the actual monthly rainfall during the season 1933-34.

TABLE 1.—*Monthly Rainfall at Experimental Centres.*

	York.		Kendenup.		Pinjarra.		Bunbury.		Harvey.		Serpentine.		Kulikup.		North Dandalup	
Month.	1933.	Average 56 years.	1933.	Average 32 years.	1933.	Average 54 years.	1933.	Average 56 years.	1933.	Average 30 years.	1933.	Average 28 years.	1933.	Average 7 years.	1933.	Average 8 years.
n. ...	25	30	171	55	67	35	67	43	104	42	78	37	57	42	55	51
b. ...	19	44	15	67	24	41	18	53	25	54	49	43	39	29	32	27
ar. ...	125	63	190	111	49	85	37	99	34	78	50	81	124	111	58	113
pl. ...	45	82	149	179	127	188	182	171	123	179	115	168	80	213	160	210
ay ...	391	235	289	313	517	547	419	521	569	571	567	607	336	339	541	678
ne ...	301	332	673	320	1.105	753	741	718	899	811	879	775	784	387	982	708
ly ...	204	345	16	395	577	727	424	687	660	785	523	802	359	416	545	888
g. ...	212	285	249	331	662	622	495	527	515	605	480	599	379	310	592	657
pt. ...	115	161	244	300	401	394	327	364	517	450	327	424	232	298	408	477
t. ...	221	108	401	243	491	259	368	241	581	291	420	245	275	151	452	305
v. ...	5	41	162	107	46	93	22	99	33	108	45	84	39	70	7	102
c. ...	Nil	41	125	83	27	60	14	57	45	59	Nil	52	24	?	19	45
Total	1.663	1,766	2,784	2,504	4,093	3,804	3,114	3,580	4,105	4,033	3,533	3,917	2,728	2,366	3,851	4,261

It will be seen that, with few exceptions, no useful rainfalls occur during the six months from November to April each year.

The whole of the cost involved in carrying out the eight trials reported herein has been generously borne by Cuming, Smith & Mt. Lyell Farmers' Fertilisers, Ltd., and Nitrogen Fertilisers Pty., Ltd., while the planting and supervision have been carried out by these companies' joint Field Officer, Mr. G. N. Lowe, co-operating with officers of the Department of Agriculture.

The trials were inaugurated in 1931-32, but no standard plan was adopted at that time, and, as it was considered that the results from single trials would yield little reliable information, all rotational grazing experiments were carried out on a uniform plan as from the 1933-34 season.

The object of the trials reported below is to determine—

(1) whether added grazing can be obtained from an addition of sulphate of ammonia to the superphosphate ordinarily used; and

(2) what quantity of sulphate of ammonia, if any, is desirable.

D. Bevan & Sons, Serpentine.

The following fertilisers were used:—

Plot 1—Superphosphate (control)	.. ..	2	cwts.	per acre in autumn.
„ 2—Superphosphate + ..	.. ..	2	„	„ „
Sulphate of ammonia	.. ..	1	„	„ „
„ 3—Superphosphate + ..	.. ..	2	„	„ „
Sulphate of ammonia	.. ..	2	„	„ „

The soil consisted of a sandy to sandy loam over-lying a clay to clayey gravel.

The whole area was sown originally in 1932-33 with a mixture of perennial ryegrass, cocksfoot and white clover.

During the season 1933-34 perennial ryegrass had established itself well, but the cocksfoot and white clover were only evident in limited numbers. Associated with the ryegrass, however, were other annual grasses, such as soft brome (*B. hordeaceus*), sterile brome (*B. sterilis*), silver grass (*Festuca myuros*), etc., along with subterranean clover and other annual minor types. This pasture contained about 70 per cent. of grasses.

Table 2 gives the results for 1933-34 season:—

Fertiliser and Plot No.	Grazing Days—Cows.	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
			£ s. d.	£ s. d.	£ s. d.	
1. Super. (Control)	138	100	0 9 9	2 9 6	1 19 9	100
2. Superphosphate Sulph. Ammonia	251	182	1 3 0	4 10 0	3 7 0	167
3. Superphosphate Sulph. Ammonia	277	200	1 16 2	4 18 9	3 2 7	157

More grazing days would have been obtained had not the plots been allowed to get ahead of the stock towards the end of the spring. The mower was used later, but not until the pasture plants had commenced blooming, consequently full use was not made of the grazing provided. These plots were grazed by cows.

F. Walton Rowe, Kendenup.

Originally this trial was sown with perennial ryegrass, cocksfoot and white clover, and included in the manurial treatments. Monamphos No. 2 and n tro chalk v. superphosphate at 2 cwt. plus 200 lbs. of sulphate of ammonia per acre, the plant foods per acre being balanced.

After two years the concentrates were no longer available, when the treatments were altered to superphosphate (control) v. superphosphate and sulphate of ammonia in autumn at varying rates of sulphate of ammonia per acre.

The following fertilisers were used during 1933-34:—

Plot 1—Superphosphate (control)	.. ..	2	cwts.	per acre in autumn.
„ 2—Superphosphate + ..	.. ..	2	„	„ „
Sulphate of ammonia	.. ..	0½	„	„ „
„ 3—Superphosphate + ..	.. ..	2	„	„ „
Sulphate of ammonia	.. ..	1	„	„ „
„ 4—Superphosphate + ..	.. ..	2	„	„ „
Sulphate of ammonia	.. ..	1½	„	„ „
„ 5—Superphosphate + ..	.. ..	2	„	„ „
Sulphate of ammonia	.. ..	2	„	„ „

Perennial ryegrass and white clover were well established during the season 1933-34, growing in association with other annual grasses and clovers with very little cocksfoot present.

Table 3 gives the results for the 1933-34 season:—

Fertiliser and Plot No.	Grazing Days—Cows. *	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days - 2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
			£ s. d.	£ s. d.	£ s. d.	
1. Super. (Control)	464	100	0 10 0	8 5 9	7 15 9	100
2. Superphosphate Sulph. Ammonia	405	97	0 16 9	7 5 0	6 8 3	82
3. Superphosphate Sulph. Ammonia	577	124	1 3 6	10 6 0	9 2 6	117
4. Superphosphate Sulph. Ammonia	474	102	1 10 3	8 9 3	6 19 0	89
5. Superphosphate Sulph. Ammonia	498	107	1 16 8	8 17 10	7 1 2	90

* Based 1 cow = 8 sheep.

Plot No. 3 probably was influenced by the residual values from the previous season's trial, as the plot originally was fertilised with 2 cwt. superphosphate and 200 lbs. sulphate of ammonia per acre during the period in which the nitro chalk and monamphos were under trial.

The above plots were grazed by sheep.

Homebush Stud Farm, Cookernup.

This plot originally was established in 1931-32 season with a perennial ryegrass, cocksfoot, white clover mixture, and during the years 1931-32 and 1932-33 the following results were obtained from the different manurial treatments:—

	1931-32.	1932-33.
Superphosphate (control) .. 2 cwts. per acre	100%	100%
Autumn 1 cwt. Spring 1 cwt.		
Superphosphate .. .. 2 cwts. per acre—autumn Sulphate of ammonia .. 1 „ „	134%	129%
Superphosphate .. .. 2 „ „ „ Autumn 1 cwt. Spring 1 cwt. Sulphate of ammonia .. 1 „ „ Autumn ½ cwt. Spring ½ cwt.	103%	114%

From the above it was decided that the spring dressing is only desirable when closing the paddocks for meadow hay in the late spring; consequently this grazing trial was brought into line with the others, using an autumn topdressing only.

During the autumn, 1933, the following fertilisers were applied:—

Plot 1—Superphosphate (control) .. .. 2 cwts. per acre.
„ 2—Superphosphate + ... 2 „ „
Sulphate of ammonia .. .. .. 1 „ „
„ 3—Superphosphate + ... 2 „ „
Sulphate of ammonia .. .. .. 2 „ „

The pasture consisted mainly of subterranean clover with annual grasses and minor clovers.

Table 4 gives the results for 1933-34:—

Fertiliser and Plot No.	Grazing Days — Cows.	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days— 2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
			£ s. d.	£ s. d.	£ s. d.	
1. Super. (Control)	267	100	0 9 9	4 15 4	4 5 7	100
2. Superphosphate Sulph. Ammonia	417	156	1 3 0	7 8 10	6 5 10	146
3. Superphosphate Sulph. Ammonia	463	170	1 16 2	8 5 4	6 9 2	150

The above plots were grazed by cows.

N. F. Lee, North Dandalup.

The composition of this pasture was a mixture of kikuyu grass and subterranean clover.

The same type of fertilisers were used, as in the previous trial, for both seasons 1932-33 and 1933-34.

Table 5 gives the results of the 1933-34 season:—

Fertiliser and Plot No.	Grazing Days — Cows.	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days— 2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
			£ s. d.	£ s. d.	£ s. d.	
1. Super. (Control)	86	100	0 9 9	1 10 9	1 1 0	100
2. Superphosphate Sulph. Ammonia	119	140	1 3 0	2 2 6	0 19 6	93
3. Superphosphate Sulph. Ammonia	171	200	1 16 2	3 1 1	1 4 11	120

The conditions for growth during the early portion of 1933-34 season were distinctly unfavourable, owing to the comparatively low rainfall and extremely cold conditions which retarded the growth of the pasture.

The plots were grazed by cows.

W. G. Burges, York.

This experiment consisted of three plots of 2 acres each, which, after a thorough preparation, were seeded down on 27th May, 1933, with 6 lbs. of *Phalaris tuberosa* per acre, and an excellent germination was obtained.

Owing to the slowness of establishment of *Phalaris tuberosa* during its first season, it was realised that nothing exceptional in the way of grazing could be obtained from *Phalaris tuberosa* until after its first season, if it were able to persist through the dry summer months.

Naturally, therefore, the grazing afforded was very largely from annual grasses with the minor clovers.

Following a very cold, unfavourable winter period, extreme summer conditions obtained, and despite every care a very small percentage of Phalaris plants persisted.

The fertiliser treatment was the same as for the previous trials.

Table 6 gives the results for the first season, 1933-34:—

Fertiliser and Plot No.	Grazing Days—Cows. *	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
			£ s. d.	£ s. d.	£ s. d.	
1. Super. (Control)	69	100	0 9 9	1 4 6	0 14 9	100
2. Superphosphate Sulph. Ammonia	148	210	1 3 0	2 12 10	1 9 10	200
3. Superphosphate Sulph. Ammonia	199	286	1 16 2	3 11 0	1 14 10	233

* One cow = eight sheep.

The above plots were grazed by sheep.

Captain L. Craig, Dardanup.

After a thorough soil preparation in the early winter, 1932, the plots were seeded with perennial ryegrass (certified), cocksfoot, and white clover, the latter, however, being eliminated by the clover springtail and red mite.

During the following summer a good growth of perennial ryegrass persisted with only a little cocksfoot, the grazing being obtained almost solely from the perennial ryegrass.

In the 1933-34 season the pasture consisted of perennial ryegrass and subterranean clover with other annual minor grasses and clovers.

The same fertiliser treatment was used as in the previous plots.

Table 7 gives the results for season 1933-34:—

Fertiliser and Plot No.	Grazing Days—Cows.	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
			£ s. d.	£ s. d.	£ s. d.	
1. Super. (Control)	239	100	0 9 9	4 5 4	3 15 7	100
2. Superphosphate Sulph. Ammonia	251	105	1 3 0	4 9 7	3 6 7	88
3. Superphsophate Sulph. Ammonia	279	117	1 16 2	4 19 7	3 3 5	84

The above plots were grazed by cows.

Owing to the experimenter's home having been destroyed by fire during the period of the trial, farm routine was badly upset, and proper attention to the conditions laid down for the experiment could not be given. Consequently all the growth available was not grazed during the end of the spring, and was later mown when in seed head.

The aftermath was grazed by sheep, but no record of this was made. The number of grazing days, therefore, was considerably reduced.

Estate of J. Staniforth-Smith, Kulikup.

This experiment was established in 1932, but proper attention as to rotational grazing was not given until the 1933-34 season.

The pasture consisted of perennial ryegrass with other annual grasses and some clovers.

The same fertiliser treatment was given as for the previous experiments, with the following results:—

TABLE 8.—*Results, 1933-34 Season.*

Fertiliser and Plot No.	Grazing Days—Cows. *	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
			£ s. d.	£ s. d.	£ s. d.	
1. Super. (Control)	42	100	0 9 9	0 15 0	0 5 3	100
2. Superphosphate Sulph. Ammonia	191	451	1 3 0	3 8 3	2 5 3	500
3. Superphosphate, Sulph. Ammonia	230	545	1 16 2	4 2 2	2 6 0	520

* Grazing was carried out by sheep. Based 1 cow = 8 Sheep.

Summarising the above results, Table 9 gives the average production, etc., for the 1933-34 season:—

Fertiliser and Plot No.	Grazing Days—Cows.	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
			£ s. d.	£ s. d.	£ s. d.	
1. Super. (Control)	186·4	100	0 9 9	3 6 7	2 16 10	100
2. Superphosphate Sulph. Ammonia	279·1	150	1 3 0	4 19 8	3 17 8	137
3. Superphosphate Sulph. Ammonia	302·4	167	1 16 2	5 8 0	3 11 10	125

On all trials, lime and potash strips were used, but at one farm only was any definite result obtained, this being from potash, where the sheep showed a definite preference for the area where potash had been applied. No noticeable difference observationally or from any preference on the part of the stock was obtained from the limed strips.

Paterson Bros., Pinjarra.

This trial is not included in the above, owing to the failure of the pasture plants during the first season.

In 1933 it was decided to sow down the area with kikuyu grass, which gave promise of persisting through the summer. The planting was carried out in the spring, giving approximately 100 per cent. "strike."

The grazing results shown in the table below are, therefore, practically obtained from winter annuals and, to some extent, Guildford grass.

Tab'e 10 shows results for 1933-34 season:—

Fertiliser and Plot No.	Grazing Days—Cows.	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
			£ s. d.	£ s. d.	£ s. d.	
1. Super. (Control) 2 cwts. per acre (Autumn)	61	100	0 9 9	1 1 8	0 11 11	100
2. Super. 2 cwts., Sulph. Ammonia ½ cwt. (Autumn)	48	78	0 16 5	0 17 5	0 1 0	8
3. Super. 2 cwts., Sulph. Ammonia 1 cwt. (Autumn)	61	100	1 3 0	1 1 8	*0 1 4	...
4. Super. 2 cwts., Sulph. Ammonia 1½ cwts. (Autumn)	61	100	1 9 8	1 1 8	*0 8 0	...
5. Super. 2 cwts., Sulph. Ammonia 2 cwts. (Autumn)	71	112	1 16 2	1 5 4	*0 10 10	...

* Loss.

Table 11 shows compiled results of fertiliser applications to pastures in the South-West:—

Fertiliser and Plot No.	Grazing Days—Cows.	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
			£ s. d.	£ s. d.	£ s. d.	
1. No Fertiliser ...	56	100	...	1 0 0	1 0 0	100
2. 1 cwt. Super. (Autumn)	148	263	0 4 11	2 12 10	2 7 11	240
3. 2 cwts. Super. (Autumn)	186	330	0 9 9	3 6 7	2 16 10	285
4. 2 cwts. Super., 1 cwt. Sulphate Ammonia (Autumn)	279	500	1 3 0	4 19 8	3 16 8	385
5. 2 cwts. Super., 2 cwts. Sulphate Ammonia (Autumn)	302	540	1 16 2	5 8 0	3 11 10	360

Figures for *no fertiliser* and 1 cwt. superphosphate per acre were obtained from topdressing results for four years, 1923-1926, over 65 plots. Results were published in Leaflet No. 208—"Pastures," by P. G. Hampshire, Department of Agriculture, Perth.

CONCLUSIONS.

Although the trials have been conducted on standard lines for only one year, the results have been fairly uniform over the seven centres so that it is believed that tentative conclusions of at least one aspect can be drawn.

(a) The need in Western Australia is for a supply of nutritious fodder during early winter after the soil supply of nitrogen, which has been made available during the summer by nitrification, has been exhausted.

Superphosphate alone will not give this early bite, particularly where annual clovers only form the bulk of the pasture.

In order to secure this early bite, a nitrogenous fertiliser seems of special value.

In all the experiments sulphate of ammonia has been used to supply the required nitrogen.

(b) Table 9 shows that there is an average of 50 per cent. increase in grazing by an application of 1 cwt. sulphate of ammonia with superphosphate as a base. Where the sulphate of ammonia is increased beyond 1 cwt., the increase is at a diminishing rate.

(c) Table 11 shows that in addition to greater dressings than 1 cwt. sulphate of ammonia returning lesser rates of increase in grazing, the profit from greater weights than 1 cwt. per acre rapidly decline. This probably is due to the depressing effect of large applications of nitrogenous fertiliser to leguminous pastures, and is greater on the average pasture in Western Australia by reason of the fact that in only a few instances are perennial grasses existent.

These conclusions are for non-irrigated pastures, as under irrigation conditions it is known that larger applications, spread over the months during which irrigation water is applied, are profitable.

(d) On all plots dressings of potash and lime were applied.

In no instance was a greater growth noticed on any limed plot, but lime should not be regarded as a fertiliser but as a corrective for soil acidity, and, where repeated applications of sulphate of ammonia are being made, care should be taken that the lime content of the soil is maintained.

On one trial the sheep showed a definite preference for the area fertilised with potash, although any increase in bulk was not noticeable to the eye.

Further trials are being made with potash fertilisers on pasture.

SORGHUM, SUDAN GRASS, AND JOHNSON GRASS POISONING.

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The three names given above are somewhat misleading, as Sudan Grass and Johnson Grass are really Sorghums themselves, being S. halepense var. sudanense and S. halepense respectively. For convenience, however, these two are kept separate from the remainder of the species of agricultural importance which are commercially grouped as Sorghums.

Sudan Grass in particular has become quite an important annual summer crop in this State, for grazing as well as hay and silage purposes, but from time to time this grass has been suspected of poisoning stock.

The following extracts should help to elucidate the position regarding the toxicity of the various species:—

1. Sorghum—Sudan Grass Hybrids—A. W. S. Moodie. *Agricultural Gazette*, N.S.W., Oct. 1, 1929:—

"It is well known that Sorghum should be allowed to flower before being fed to stock, whereas pure Sudan grass can be fed at any stage of growth. It was therefore concluded, and field observations have confirmed the opinion, that hybrids produced by accidental interpollination were likely to prove as toxic during their early stages of growth as young sorghum plants.

With a view to obtaining definite information, tests were carried out on Sorghum-Sudan Grass hybrids.

Local and overseas investigations concerning sorghum have shown that—

(a) It is quite safe when it reaches the flowering stage.

(b) There is danger from poisoning, especially in the case of large stock, from young growth or 'second growth' coming away after the main crop has been harvested.

(c) Young growth that is frosted, or stunted growth caused by drought conditions, is often highly toxic.

(d) Cutting the immature crop and allowing it to wilt for at least twenty-four hours before feeding is often effective in rendering the material harmless, but sometimes mortality will occur even when this precaution has been taken."

A general summary of the article is as follows:—

Pure Sudan Grass is perfectly safe to feed to stock at any stage of growth.

Sorghum should be allowed to reach the flowering stage before being grazed or fed to stock.

Hybrids, the progeny resulting from the crossing of Sudan Grass and Sorghum may contain much more hydrocyanic acid than Sorghum.

2. Hydrocyanic acid content of Sorghum-Sudan hybrids—A. A. Ramsay, Agricultural Gazette, N.S.W., Oct. 1, 1929.

Estimation of hydrocyanic acid in various samples gave the following results:—

The quantity containing the minimum fatal dose for sheep—

Pure Sudan Grass, 1,333 lbs.

Pure Saccaline Sorghum, 4.4 lbs.

Hybrids, 1.2 to 133 lbs.

Most of the hybrids were evidently more toxic than the Sorghum parent with the pure Sudan Grass not containing sufficient hydrocyanic acid to be dangerous.

3. Poisoning of cattle by Sorghum and Allied Plants. H. Wenholz—Agricultural Gazette, N.S.W., Feb. 1, 1922.

"From a comparison of the amount of prussic acid set free from given quantities of Sorghum and Sudan Grass with the amount of combined acid required to produce fatal results, the quantity of fresh, young Sudan Grass which an animal would need to eat for the effect to be fatal has been estimated at 19 lbs. and of the fresh young Sorghum at 7½ lbs. These figures are based on the assumption that all the acid is set free in the animal's stomach. Fortunately, however, conditions are against the complete liberation of the acid, and the amounts mentioned have been eaten, and can be eaten, with impunity.

"Investigation and ordinary farm practice have shown that, when cured as fodder or hay, or even so long as they have been allowed to wilt for 24 hours after being cut, Sorghum and Sudan Grass may usually be fed to stock with

safety. It has been proved that comparatively large quantities of these fodders may be fed thus without producing any signs of poisoning. This apparent harmlessness of cured or wilted Sorghum and hayed Sudan Grass is attributed to the destruction of the activity of the enzyme on being dried. Another general experience has been that Sudan Grass or Sorghum injured by drought or other adverse climatic conditions contains a larger quantity of prussic acid than when the crop has made vigorous normal growth. This point has been verified by the results of actual chemical analysis, more than twice the quantity of prussic acid being found in Sorghum stunted by drought or injured by frost than in Sorghum of normal growth.

"On the other hand it has been shown that Sorghum grown on poor soil contains less prussic acid than that grown on a rich soil, especially if the poor soil is low in nitrates.

"That the percentage of prussic acid in Sorghum decreased steadily from the time the plant begins growth until it ripens seed (presuming the growth has been normal) is generally agreed by both chemists and farmers."

In America and New South Wales evidence suggests a relationship between climate and toxicity, and some American chemists consider that varietal difference is probably of more significance in the determination of the amount of prussic acid in Sorghum than are conditions of growth.

4. E. Breakwell—Grasses and Fodder Plants of New South Wales (1923).

"Although no direct reports have been received in this State concerning the poisonous action of Johnson Grass, that hydrocyanic or prussic acid exists in the grass has been proved in California. Most sorghums are poisonous in character, and as this grass belongs to the Sorghum family, it is well to bear in mind the conclusion of the Brisbane chemist, Brunnich:—All fodder plants related to Sorghum must be used with discretion in either the green or the dried state, and should not be given in large amounts to animals which have fasted for some time."

"Investigations were carried out in 1920-21 by the Stock Branch, Department of Agriculture, by feeding Sudan Grass at all stages of growth, and they were attended by entirely negative results. Thousands of acres have since been pastured by sheep and cattle without harmful effects."

"The following warning has been issued by the Stock Branch of the Department of Agriculture in relation to this subject:—

1. Sudan Grass is most likely to be harmful to cattle when immature or stunted through drought.

2. If cattle are put on Sudan Grass, care should be taken that they are only put on it for a short time at first.

3. When cut and dried it is unlikely to be harmful.

4. So far as prussic acid is concerned, the grass may be safely grazed by horses or pigs, and is unlikely to be as dangerous to sheep as to cattle."

"Sorghum poisoning is of fairly common occurrence in Australia, and has also been reported from America and Egypt. The latest investigations in the prussic acid content of Sorghums have led to the following conclusions:—

1. When Sorghums are grown on poor infertile soils, added nitrogen may slightly increase the amount of hydrocyanic acid in the plant. With a fertile soil and abundant nitrogen this effect may not be produced.

2. During the first three or four weeks of the plant's life, the prussic acid is concentrated in the stalks. Then it rapidly disappears there, but apparently persists in the leaves in decreasing percentages until maturity.

3. Climate and variety may be more important factors than soil nitrogen in determining the amount of acid in the plant.

"The mature Sorghum is harmless and can be fed with perfect safety."

5. P. Ryan—Summer Fodder Crops.—*Journal of Agriculture,* Vic., Sept., 1929.

"While Sudan Grass belongs to the Sorghum family, there is much less danger of prussic acid poisoning from pasturing it than is the case with other Sorghums. Indeed, provided that the seed sown is pure and due care is exercised, there is very little danger in grazing at any stage of growth unless the crop has suffered a severe check by frost or drought. Sudan Grass readily crosses with other Sorghums, and the plants resulting from the cross seem to take on the poisonous properties of the Sorghums."

6. Prussic acid in Sorghums—S. E. Collison. Bull. 155, University of Florida. Dec, 1919.

"In conclusion it may be said that so far as our knowledge goes at present, there may be some danger in feeding fresh Sorghum or allowing cattle to pasture on fresh Sorghum, if the forage is taken on an empty stomach. To avoid this risk, the material should either be fed after it has been slowly cured or should be given after or in connection with other feeds. Used in this way it is believed that little risk would be incurred in feeding Sorghum grown under normal conditions in Florida."

7. The amount of hydrocyanic acid in Sorghum, Sudan Grass, and some Hybrids—H. Finnemore and C. B. Cox. Royal Society, N.S.W., Sept. 2, 1931.

Conclusions:—All the varieties examined yielded some hydrocyanic acid up to about 130 days after sowing, when the seeding stage had been passed, but the amounts varied considerably. Some gave larger percentages than have hitherto been recorded. Sudan Grass gave the least and Feterita the most.

Owing to slow germination only two of the eight hybrids were available at the time of the first examination, but from the second series of results it seems that these hybrids are lower in hydrocyanic acid, at all events in the first month or two, than the majority of the Sorghums.

The results of other workers have been confirmed in that the percentage of hydrocyanic acid has been found to be greatest in young plants and to diminish as growth proceeds.

. . . . it would appear that young Sorghum, even when wilted, cannot always be considered safe as fodder.

8. The Toxicity of Sorghum halepense (Johnson Grass) for sheep—F. H. Manley. Veterinary Journal, London, June, 1932.

Conclusion:—"Sorghum halepense, when dried in the early stages of its development, is extremely poisonous for sheep. Insufficient material was available on this occasion to thoroughly determine the toxicity of the fresh young grass. In the later stages of growth the plant appears to be definitely non-toxic."

From the preceding extracts the following conclusions have been drawn:—

Johnson Grass, Sorghum, and Sorghum-Sudan Grass hybrids must all be regarded as potential sources of hydrocyanic acid poisoning until they have reached the flowering stage. The poisonous properties are likely to be most marked if the plants have been stunted by frosts or dry conditions or if grown on soils rich in nitrogen. Wilting does not necessarily destroy the dangerous properties, although it often has that effect. There is some difference of opinion regarding the relative amounts of hydrocyanic acid in Sorghums and hybrids. Climatic conditions evidently play a large part with regard to the quantity of hydrocyanic acid present. The percentage decreases steadily from the time the plant begins growth until it ripens seed, provided the growth has been normal.

Sudan Grass, when free from hybrids, is not likely to be dangerous at any stage of growth, but has the greatest risk where the grass has been stunted by frost or dry conditions. Any risk is minimised by wilting for twenty-four hours prior to feeding. If cattle are to be grazed on Sudan Grass, care should be taken that they are only put on it for a short time at first, particularly if they are hungry. Sudan Grass is as likely to cause hoven or bloat as any other succulent forage.

These conclusions are in conformity with local experience. No authentic case of poisoning due to pure Sudan Grass either during grazing or when used as a cut crop is known, but several fatalities have been traced, with little doubt, to stock eating Sorghum-Sudan Grass hybrids. As these are found usually along with a crop of Sudan Grass, it is natural that persons suffering losses would suspect the Sudan Grass as being the cause of the trouble.

BREEDING FOR 1934.

G. D. SHAW,
Poultry Adviser, Department of Agriculture.

The breeding season is now uppermost in the minds of those engaged in the poultry industry.

Correct mating of the proper birds will go far to ensure a profitable hatching season. The far-seeing breeder has been nursing his breeders through their moulting period by feeding the birds a ration which has brought them through the moult ready to lay eggs of high vitality and hatchability.

Most birds of high egg production must be forced into a moult and this has been done by withholding all egg forcing feeds and feeding only those foods which replace feathers and wasting tissues. Vegetable proteins have been the order and animal proteins withdrawn from the feeds.

The strain on a pullet during her first laying season has been enormous, and it is false economy to allow the high egg producer to keep on laying through the moult, straining her energy and vitality, and then to expect her to produce the egg which gives vitality to the chick. By feeding to stop laying, she has had a chance of a rest and so starts her vital period of chick production well fitted for the work in front of her.

Do not feed breeding pens on a laying-pen mash; rather aim for the hatchable egg than the numbers. The mash should be so constituted as to keep the birds in good condition.

A good breeding ration is—

8 parts green feed,
4 „ bran } or { 5 parts bran,
4 „ pollard } or { 3 „ wheat meal,
½ part meat meal,
¼ „ bone meal,

with wheat as an evening grain (1 "golden syrup" tin to every 12 birds), followed up by green feed.

Watch the male. He is half the pen. His vitality fertilises all the eggs from the pen, and, should he be run down or starved because of his gallantry, feed him separately. Do not make a practice of changing the males unless the eggs are unfertile. All breeding should be done to a system, and changing males throughout the season causes this system to break down.

Collect the eggs many times daily and store in a cool place. Stack eggs air-cell up at an angle of 45 degrees, and use only clean eggs. Rub off any foreign matter.

If the eggs are to be kept over three days, turn them daily and keep them from draughts, thus retarding evaporation. Operate the incubators to maker's instructions until a grasp is obtained of each machine's peculiarities, when personal knowledge will teach how to hatch out more chicks.

Chicks.

The feeding of chicks is a subject which causes many arguments, but the recommended practice is to feed for body and not eggs until the pullet has completed her first laying season. Even in 1934 one hears boasting that birds came into lay at 4½ to 5 months old, but this indicates the birds have not been fed for body.

Providing one feeds the right food and the chicks keep growing, one should not worry if the pullets are 6½ to 7 months old before they start to lay. Aim for body size and egg capacity and do not tolerate the small bird at all. Keep the chicks moving by withholding animal protein as long as possible and feed the grain heavily. During the first two or three days, give flaked bran, grit and plenty of good water. This should be followed with bran and wheatmeal of equal quantities with cracked wheat at the evening feed. Keep to that ration as a *dry* mash for four weeks, then add 5 per cent. meat meal and 2½ per cent. bone meal (bulk quantities) until the chicks are 12 weeks old. From 12 weeks to 5 months a wet mash can be given in the morning with the dry mash in front of them always.

Green feed should be incorporated in the wet mash, equal quantities in bulk to the other ingredients.

At 5 months feed on the breeder's mash and continue until the pullet has finished her first laying season.

Always feed chaffed up greens after a wheat or cracked wheat feed and have charcoal and shell grit always before the young chicks. It is surprising how much they can consume.

POTATO FERTILISER TRIALS UNDER IRRIGATION AT WAROONA.

E. T. MORGAN,
Officer-in-Charge Potato Branch;
J. C. PALMER, Dip. Agric.,
Potato Inspector.

This is the first occasion on which potato trials under irrigation have been conducted by the Potato Branch of the Department of Agriculture, and is the first of a series to be conducted in irrigation areas.

As much land will be used for the growing of potatoes in the Brunswick-Dardanup area under the Collie irrigation scheme, it is intended to give hints, in this article, of the practice adopted in the Waroona district, where irrigation of potatoes has been carried out with great success for the past 10 years.

FERTILISER TRIAL.

Through the courtesy of Mr. J. Salerian, of Waroona, a portion of new land on his property was made available for the experiments, and we are greatly indebted to him for his care and attention in watering and cultivation. The land selected had previously been timbered with blue gums and large paper barks, and may be described as a sandy loam, well furnished with humus, overlying a somewhat impervious clay at a depth of 18 inches from the surface, which ranged in colour from chocolate to red.

Whole "round" seed of the Delaware variety was used. This was grown on the hills at Young's Siding, harvested in July, and transported to Waroona, where it was immediately racked and allowed to green and sprout.

In planting the area the local practice was followed. The land had been cultivated with a tractor and rotary hoe to a depth of nine or ten inches, and was in excellent condition and thoroughly moist. Each "land" was planted with six rows spaced about 2ft. 6ins. apart with a deep finish which acted as an irrigation ditch between each land.

The tubers were planted after the plough, which was set to plough at a depth of about 9 inches, the potatoes being planted about halfway up the turned furrow, or from 4 to 4½ inches deep. This ensured plenty of loose soil under the tubers, and, in the case of irrigation especially, such practice gives uniformly good results. The experimental plots were planted on the 1st and 2nd of December, which is rather later than the usual planting time of the district, which ranges from October to about the second or third week in November.

Irrigation water was applied on two occasions at 20 day intervals, and a fall of rain of approximately two inches was experienced on March 26, which rendered further irrigation unnecessary.

Germination and growth were excellent, but "Early Blight" made its appearance in the later growing stages and to some extent limited the life of the plants—not allowing of full maturity. Nevertheless good yields were reported, as the figures will show.

Each plot was 1/200th of an acre and was replicated four times. The tables show the average weights obtained from each manurial treatment.

This trial was devised to ascertain whether—

(a) a complete manure 4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash is better than no manure;

(b) A complete manure is better than one of 12 cwt. super. alone;

(c) the difference between 12 cwt. super. and no manure.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre. tons.	cwt.	Per cent.
1	1	No manure	0	10	5
	2	4cwt. sulphate ammonia, 12cwt. super. ..., 2cwt. sulphate potash } Control	11	3	100
	3	12cwt. super.	7	3	64

This trial was devised to ascertain whether—

(a) a complete manure, 4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash is better than 4 cwt. sulphate ammonia;

(b) a complete manure is better than one of 2 cwt. sulphate potash;

(c) the difference between the values of 4 cwt. sulphate ammonia and 2 cwt. sulphate potash.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre. tons.	cwt.	Per cent.
2	1	4 cwt. sulphate ammonia	1	3	12
	2	4 cwt. sulphate ammonia, 12 cwt. super. ..., 2 cwt. sulphate potash } Control	9	18	100
	3	2 cwt. sulphate potash	0	16	9

This trial was devised to ascertain whether—

(a) a complete manure 4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash is better than one of 4 cwt. sulphate ammonia and 12 cwt. super.

(b) a complete manure is better than one of 12 cwt. super. and 2 cwt. sulphate potash;

(c) the difference between the values of 4 cwt. sulphate ammonia and 12 cwt. super. and 12 cwt. super. and 2 cwt. sulphate potash.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre tons.	cwt.	Per cent.
3	1	4 cwt. sulphate ammonia, 12 cwt. super }	11	6	84
	2	4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash } Control	13	9	100
	3	12 cwt. super. ..., 2 cwt. sulphate potash }	9	13	71

This trial was devised to ascertain whether—

(a) a complete manure 4 cwt. sulphate ammonia, 12 cwt. super., and 2 cwt. sulphate potash is better than 4 cwt. sulphate ammonia and 2 cwt. sulphate potash.

(b) a complete manure is better than one of 4 cwt. sulphate ammonia, 4 cwt. super., and 2 cwt. sulphate potash.

(c) the difference between a mixture of 4 cwt. sulphate ammonia, 4 cwt. super., and 2 cwt. sulphate potash and one of 4 cwt. sulphate ammonia and 2 cwt. sulphate potash.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre. tons	cwt.	Per cent.
4	1	4 cwt. sulphate ammonia 2 cwt. sulphate potash	0	12	5
	2	4 cwt. sulphate ammonia 12 cwt. super. 2 cwt. sulphate potash Control	12	14	100
	3	4 cwt. sulphate ammonia 4 cwt. super. 2 cwt. sulphate potash	7	12	60

This trial was devised to ascertain whether—

(a) a complete manure—4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash is better than 4 cwt. sulphate ammonia, 8 cwt. super., 2 cwt. sulphate potash;

(b) a complete manure is better than one of 4 cwt. sulphate ammonia, 16 cwt. super., 2 cwt. sulphate potash;

(c) the difference between mixtures of 4 cwt. sulphate ammonia, 16 cwt. super., 2 cwt. sulphate potash and 4 cwt. sulphate ammonia, 8 cwt. super., 2 cwt. sulphate potash.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre. tons.	cwt.	Per cent.
5	1	4 cwt. sulphate ammonia 8 cwt. super. 2 cwt. sulphate potash	12	14	118
	2	4 cwt. sulphate ammonia 12 cwt. super. 2 cwt. sulphate potash Control	10	14	100
	3	4 cwt. sulphate ammonia 16 cwt. super. 2 cwt. sulphate potash	12	15	119

This trial was devised to ascertain whether—

(a) a complete manure—4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash—is better than 2 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash;

(b) a complete manure is better than one of 6 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash;

(c) the difference between the mixtures 6 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash and 2 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash.

Set.	Plot.	Fertiliser.		Calculated Yield per Acre. tons.	cwt.	Per cent.
6	1	2 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash	... ...	12	14	132
	2	4 cwt. sulphate ammonia, 12 cwt. super ..., 2 cwt. sulphate potash	Control	9	10	100
	3	6 cwt. sulphate ammonia, 12 cwt. super ..., 2 cwt. sulphate potash	... ...	10	14	112

This trial was devised to ascertain whether—

(a) a complete manure—4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash—is better than 4 cwt. sulphate ammonia, 12 cwt. super., 4 cwt. sulphate potash;

(b) a complete manure is better than one of 4 cwt. sulphate ammonia, 12 cwt. super., 1 cwt. sulphate potash;

(c) the difference between mixtures of 4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash and 4 cwt. sulphate ammonia, 12 cwt. super., 4 cwt. sulphate potash.

Set.	Plot.	Fertiliser.		Calculated Yield per Acre. tons.	cwt.	Per cent.
7	1	4 cwt. sulphate ammonia, 12 cwt. super. ..., 4 cwt. sulphate potash	... ...	12	5	107
	2	4 cwt. sulphate ammonia, 12 cwt. super. ..., 2 cwt. sulphate potash	Control	11	8	100
	3	4 cwt. sulphate ammonia, 12 cwt. super. ..., 1 cwt. sulphate potash	... ...	12	14	110

Since these trials are the first of a series, which will extend over a period of three years, no conclusive results can be derived from this first trial. The results of this and of the succeeding experiments will be grouped together, and then it is to be hoped that definite information will be obtained for publication.

It was interesting to note how little difference was caused in the results obtained by varying the amounts of sulphate ammonia or sulphate potash.

There seems to be an indication, however, that a very suitable manure for this type of farming and land is a mixture of 2 cwt. sulphate ammonia, 8 cwt. super., and 1-2 cwt. sulphate potash.

General Commentary.

The successful irrigation of the potato crop is a delicate operation. In order to maintain good growth and to ensure that well-shaped tubers are harvested, well directed attention is necessary. It is common to see, in an irrigation-grown potato crop, ill-shaped second growth tubers, making many of them unsaleable. This trouble can be obviated by intelligent watering, but the method adopted must be determined, to a very great extent, by the type of soil being worked. The soil on which the trials were conducted, in common with much of the land in the

Waroona-Hamel area, allows of ready seepage, and furrows 15 to 16 feet apart allow saturation of the subsoil, the moisture rising to the surface by capillary attraction. The land in question holds the moisture well, and about 20 to 24 days between waterings has in practice been found sufficient. Where sandy types of soil are encountered, irrigation by the above method does not appear to be so satisfactory; moisture is not held readily; partial drying out occurs; and growth receives a slight check. On applying water, growth is again stimulated, and ugly, knobby tubers are invariably produced. It would be more satisfactory on this type of soil, to plant sufficiently wide to allow of moulding or ridging and running the water down the furrows made, say every second furrow at the first irrigation, alternating the rows on the second watering, and so on. Water would have to be applied more frequently, at say 10 day intervals. Of course, no hard and fast rule can be laid down as methods adopted must be determined by soil as well as climatic conditions.

The proper grading of the land must receive attention, as low places are generally a source of trouble, flooding easily occurs and much loss is suffered in the hollows as well as on some of the surrounding area. It should always be remembered that water should be applied, so that it runs into the soil underneath the tubers, and this must be done in whatever system of flood irrigation is practised. It is common to see, with new growers, shallow furrows and water everywhere, and much killing of plants in lower lying levels and even on higher places. The tubers are so watery that when dug they soon shrivel and in many cases rot right away.

Even with the potato crop that has been properly irrigated, rot is often observed, and although the tubers may appear sound at the time of digging, much loss occurs in the interim between harvesting and transportation to the markets. This loss can be obviated to a great extent by allowing the land to dry out somewhat before harvesting, which should not be done for at least 10 to 12 days after the last application of water.

Where it is intended to store irrigation grown potatoes over an extended period, they should not be dug until a good fall of rain has been received. It is not possible for the writers to explain the exact action of rain on the crop, but evidently a certain cooling and hardening takes place and practice has demonstrated that potatoes so treated have been kept in ordinary shed storage for 3 months and have been in every way satisfactory after this period.

If it is intended to leave the tubers in the ground, until after a good rain is experienced (which is generally in March or April), the land must be kept sufficiently moist to avoid the possibility of moth infection, which may occur if the land is allowed to become dry.

The effect of irrigation is to consolidate the land, and it is advisable to cultivate between the rows after each application of water, or at least as long as it is possible to run the cultivator between the drills.

The main points to be considered are:—

1. Well-cultivated land prior to planting;
2. The maintenance of an even degree of moisture, avoiding over-watering;
3. The choosing of well-graded land;
4. The necessity of not allowing water to soak into the land level with the tubers;
5. The harvesting of the crop under suitable conditions.

VINE PRUNING.

By H. K. Johns, Viticulturist.

(Portion of this article appeared in *Journal of Agriculture*, No. 3, Vol. 10, Sept., 1933.)

"The use of the grape as a food preceded the making of wine. Primitive man, who lived by the chase and on wild fruits, gathered and ate with relish the grapes of the wild vines long before he discovered that he could make a joyous beverage out of them. As time rolled on and life became more settled, he took in the grape vine from the wilderness and gave it cultivation. Then, perhaps, began the selection of the finest and best flavoured grapes, and, presently, the propagation of strains. Left to itself, deprived of man's ceaseless, thoughtful care, the grape vine would revert speedily, helplessly, to the status of its wild progenitor."—(*Extract from "Wine Lands of the World."*)

Therefore, to prune intelligently, many aspects have to be taken into consideration—the age, size, condition of the plant, the location, soil, climate, variety (whether it requires short or long pruning), the principles governing its life, and other features of its environment. Of all fruit-bearing plants, the grape vine is one that requires careful pruning, and like all other fruiting plants, it responds to pruning, and the quality of fruit is improved by it. Pruning has one or more of the following objects:—Modification of shape and habit of the plant, removal, renewal, promotion, or retarding parts of the plant, increase or decrease in size and quantity of the fruit, also training to simplify cultivation, spraying, and the harvesting of the grape crop.

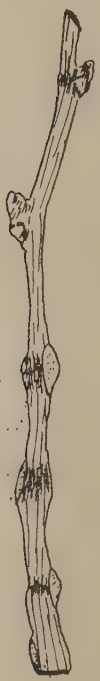
The time for pruning depends on the season's conditions. The only safe rule is that vineyards may be pruned as soon as the vines are dormant. If pruned too soon, the plants will be weakened and new growth will commence early; then, if a frost visitation is recorded, the young growing shoots will be destroyed, with loss of fruitful shoots. Early pruning will cause the vines to start early growth in the spring, while late pruning will considerably delay the shooting of the buds. Generally, in this State, pruning commences in the month of June and is completed by the end of August.

Vine cuttings for propagation may be prepared at any time after vines have become dormant, when cuttings can be selected from the parent plant. They should range from 12 to 18 inches and should always be made from young matured wood and preferably from medium-sized, short jointed wood growths arising from spurs or canes (rods) of previous season's growth. To make cuttings, cut close below the lower bud, the cut to be square across, and leave about an inch of wood above the upper bud or eye.

Each cutting should have the buds removed from the base end upwards, leaving the top two buds intact for production of growth. The reason for elimination of lower buds is to prevent entrance of dry rot, or any other attack such as white ants, which may occur from the decomposing of the buds under ground. Soon after the commencement of the rise of sap and following growth, callousing will heal over all cuts, resulting in the trunk under ground being clean and well barked throughout. Cuttings should be tied in convenient-sized bundles, all buds pointing the same way. The bundles should then be buried in trenches with butt end up and covered with about six inches of soil. Inverting the bundles causes the butts to callous while the tops remain dormant, and the cuttings are ready to

throw out a rooting system soon after planting in nursery or permanent position. If, on the other hand, they are heeled in with buds upwards, they often commence growth prior to developing root growth to support them.

When the ground has become warm enough, or in the early spring—August—plant the cuttings in well, deeply worked soil. If in nursery, set each cutting at such a depth that only the upper two buds are just above surface level, spacing them about two to four inches apart with about three feet between rows. When selecting land for propagating cuttings, it is advisable, if possible, to have the sets in a position that can be irrigated with at least three or more waterings during the summer months. Also the soil should be kept well stirred with the hoe and cultivator to keep it mellow and as moist as possible. The principle involved is to create a good rooting and head growth the first year prior to planting in permanent position.



No. 1.

A description of the parts of the vine is necessary before the subject of pruning is considered, as per illustrations Nos. 2, 3, 4, and 5.

No. 2.—Photograph of 10-year-old Gordo Blanco Muscatel grown in the Swan Valley, before pruning:—

(1) Main trunk or body of vine.

(2) Crown of vine formed at suitable commercial height for trellising.

(3) Main arms and permanent branches, which are of mature wood of several years old.

(4) Secondary arms which arise from the main arms and permanent branches.

(5) Canes of seasonal growth; when young, called "green shorts."

(6) Laterals which grow from canes in the form of seasonal secondary shoots.

(7) Water shoots which have sprouted from main trunk of vine.

No. 3.—Photograph of No. 2 after pruning:—

(1) Main trunk or body of vine.

(2) Crown.

(3) Main arms.

(4) Secondary arms.

(5) Spurs.

The system adopted in the pruning of this vine, Gordo Blanco Muscatel, is termed spur pruning along the main arm or cordon, spurs being pruned to one clear bud. Generally growers in the Swan Valley shorten back the spurs to the basal bud with the object of lightening the crop and increasing quality. This variety of vine is a prolific bearer.

Illustration No. 2.

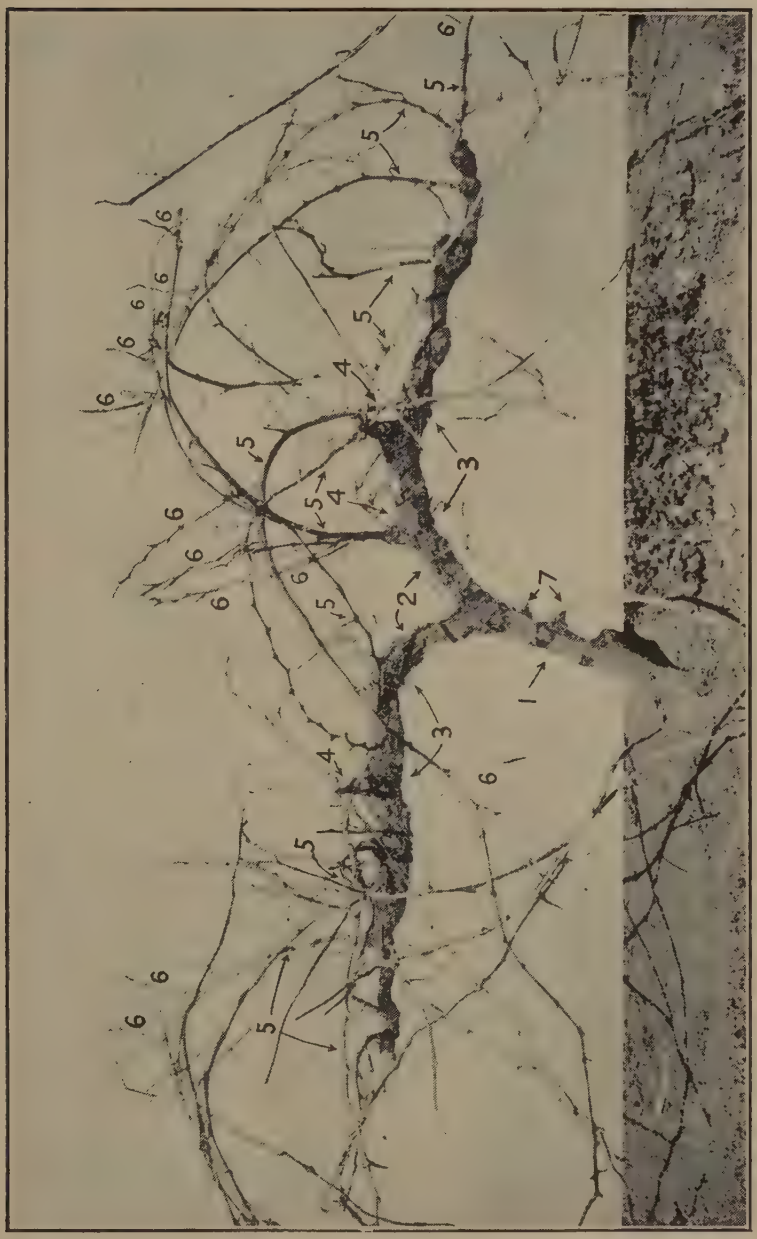


Illustration No. 3.

Illustration No. 3A.

No. 3A.—Showing crown, and portion of main arms, with subsidiary arms growing horizontally from main arms which carried the fruiting spurs, and is pruned to two distinct eyes on each fruiting spur. The variety of vine is Zante Currant.

Illustration No. 4.

No. 4.—Shows water shoots growing from main stem or body of vine. These should be pruned closely by the pruner, as shown in illustration No. 3.

Illustration No. 5.

No. 5.—Suckers which shoot from under the ground. The earth should be removed and the suckers cleanly removed by the pruner, as they are of no value, and, if allowed to exist, would rob the general growth of the parent stock.

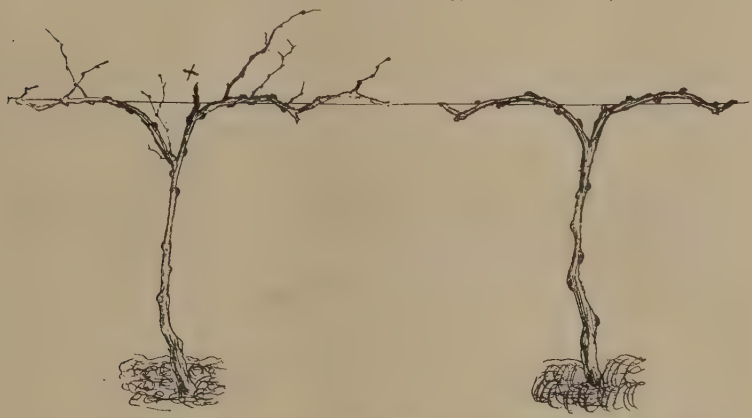
Illustration No. 6.

No. 6.—This is a sketch of a grape vine after one year's growth in nursery, and the markings indicate the pruning of roots before planting, also pruning of top portion of vine to two distinct buds. Usually no training is given the first year after planting in a permanent position.

Illustration No. 7.

No. 7.—A vine pruned after the first year in the vineyard. The most upright growth is selected and pruned to two distinct buds.

Illustrations Nos. 8 and 9.



No. 8.—This shows the growth of the vine following pruning, as in illustration No. 7. Although the vine in No. 7 was pruned to two distinct buds, only one was allowed to grow; all other young shoots have been removed during early growth, preferably when not more than six inches long. This concentrates all the force of growth of the plant into the cane which is to become the main trunk or body of the vine. Care must be taken to stake and tie the growth until it reaches the required height for formation of crown. This care is necessary as a protection against winds, and is also essential for straightness of the main trunk. When the shoot has grown to about nine to ten inches above the height required for formation of crown of vine, the terminal growth should be pinched as marked "X" in illustration (No. 8). This treatment will cause laterals to grow where desired to form main arms for shaping and construction for the following season, as will be noticed in illustration No. 9, showing same vine after pruning.

In covering high structures with trellised vines, it is necessary to train a series of vines of various heights so that the rule of maintaining the fruiting wood upon a common level on each plant may be followed. To secure the length of stem or trunk it sometimes takes a few seasons to grow a shoot of the required height. If the growth from the young vines does not ascend sufficiently far above the required height during the first year, it should at the next pruning season be again pruned back to a spur of a couple of buds to induce a new and vigorous growth, and only one shoot should be allowed to grow from it. This growth should be tied up vertically and when it reaches the required height, its terminal growth should be pinched off.

As the main stem or trunk supports the framework of the vine, raised to the desired height above the ground, the next consideration is to determine what height the length of trunk should be. This varies according to requirements and is governed by certain factors—in the field with vines trained under the Goblet, or otherwise known as the Gooseberry-bush system, a useful height is from 10 inches to 18 inches, which is desirable before crown formation. Vines with short trunk and low crown formation are liable to damage from frosts, also the grapes are likely to become damaged from cultivators and dust. The extra height will also be an advantage when pruning and disbudding the vines, and picking the fruit.

With vines to be trained and grown on trellises in the field, the trunk length varies according to variety of grape: generally, the trunk is from 2 feet in length.

Root Treatment.—A number of roots grow on many vine horizontals from the main trunk of vine just under the surface, while others grow deeper and of a straight downward growth. Those roots which stay near the surface of the soil will sooner or later suffer during a long spell of hot weather, as the vine during that period has a very heavy task to perform, that is, to propagate growth in foliage and wood, also mature and ripen the fruit. Therefore it is necessary that during the second and third year all young planted vines should have the plant dug round to a depth of not less than six inches and all roots which have developed from the main trunk of vine to depth mentioned should be cut off close to the main stem. This will help to stabilise and develop the lower rooting system, and facilitate deep cultivation, which is necessary for the first ploughing during the winter months, without injury to the vine. It is essential that young vines should be properly cared for during their period of training and formation, as the early years of growth and treatment given the vines during that term largely determine the profit and good working to be derived from them.

There are two distinct methods of pruning—spur and rod pruning—and the two methods are applied individually or in combination, according to the habit of the growth of the vine. A rule that is to be remembered is that all vines bear fruit on the new wood, but, with most varieties, bearing wood only grows from wood of the previous year's growth. Vigorous growths sometimes grow from the old wood or main arms of the vine, and are called "water shoots," and do not produce grapes in the first season, so it is a safe rule for an amateur pruner to cut water shoots away. They should only be left in case of improving the shape of the vine. Some vines produce the fruit-bearing buds at the base of their canes, whilst in the vigorous growing varieties their fruit-bearing buds are situated well along the canes; therefore we find it necessary to spur prune and rod prune.

In pruning, selected fruit-bearing canes are cut back to spurs and rods. A spur is cut back generally to two clear buds, but the number of spurs to be left on each vine is to the judgment of the pruner, as he has to consider the variety and vigour of the plant. Spurs should be from four inches to eight inches apart, the strongest and most matured canes to be used, and on no account leave a cluster of spurs. In leaving too many spurs, the vines may bear too many and too small grapes. To find the medium between these extremes is always a great object and study to which the grower should devote his attention. If more than two eyes are left, the lower eyes may not develop, and the only thing attained by such pruning is to increase the size of the head and length of secondary arms, and thus place the leaves and grapes farther away from the main centre of the vine; also the vine and grapes will suffer damage from the implements during cultivation. In pruning the spurs, the cut should be made about midway along the internode, or well above the second bud, and not so close to it that it will be injured and dry out. A rod is actually a fruit-bearing cane cut back, leaving six buds upwards to one dozen to be suppressed the following year and a replacement to be laid down where vines

grow strong and vigorous, and the variety is one that produces its fruit-bearing buds well along the canes. More wood is to be left, but there is a danger or at least a disadvantage in pruning either too short or too long, and in leaving too many spurs or rods. On leaving too many eyes, the shape of the vine is changed and becomes elongated, or even seriously injured. Definite direction of pruning cannot be applied to every locality or to every vine, as soils, variety, and climate are not all alike; therefore the methods of pruning have to be modified.

Illustration No. 10.

No. 10.—Vine before pruning, trained under the Goblet, or otherwise known as the Gooseberry-bush system. It is the simplest and cheapest method of pruning and training vines, and is in vogue in most commercial wine-growing vineyards.

Illustration No. 11.

and the method also facilitates cultivation. An ordinary vine at about five years old consists of a trunk from which spring four or five arms; arising from them are the spurs from which the canes grow and carry the fruit.

No. 11.—The same vine pruned to the Basket-handle system, which embodies the spur and rod pruning in combination. The rods are interwoven; the principle involved is the rods to carry the fruit for the ensuing season, and at the next pruning season they are suppressed by the pruner and replaced by canes or rods growth arising from the spurs.

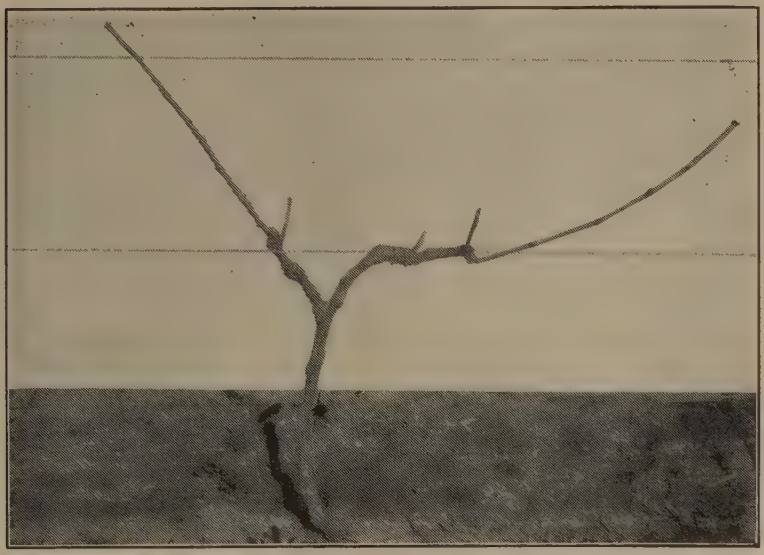
Illustration No. 12.

No. 12.—Vine pruned to the Goblet or Gooseberry-bush system. The spurs of last season are cut off just outside the inner canes, which in turn are cut back to spurs, carrying two distinct eyes or buds. The pruning each winter is to create a promotion of a regular system of spur renewal. As the vine becomes older and more vigorous, it will stand more cropping, and then more spurs are left to increase the yielding capacity of the vine. The head of the vine should be kept well balanced in shape, and as time elapses the arms of the respective spurs are renewed, and new arms and spurs are grown.

Illustration No. 13.

No. 13.—Shiraz vine before pruning.

Illustration No. 14.

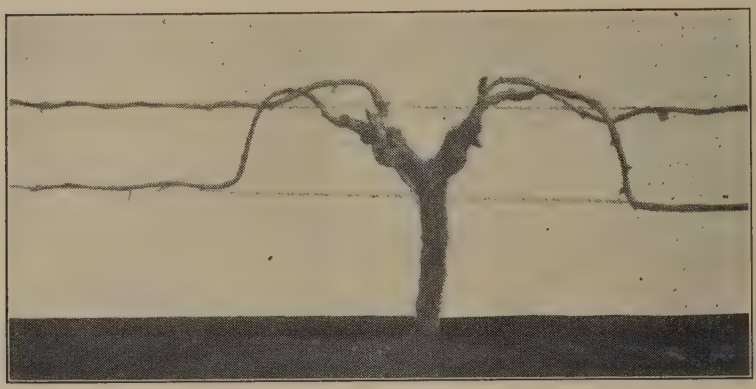


No. 14.—Shiraz vine after pruning to the Bordelais Espalier or Double Guyot system. This method is quite simple and is most suitable for varieties that require rod and spur. The annual pruning consists of removing the previous year's rods and all water shoots, and utilising the two canes from last year's spur for a rod and spur. After pruning, the rods are tied securely at the ends to the bottom trellis wire.

Illustration No. 15.

No. 15.—Sultanta vine before pruning: this variety crops heavily with long rod pruning.

Illustration No. 16.



No. 16.—Sultana vine after pruning to four long rods and also spurs pruned to two distinct buds. The rods are rolled round the trellis wire and tied at the extreme end. The number of rods to be left on the vine is a question of judgment by the pruner; the vigour of the vine, soil and climatic conditions have all to be taken into consideration.

Dr. Hogg describes this grape under the name sultana. It is a native of Anatolia and was brought from Smyrna to Greece, where it has done remarkably well, and has subsequently spread to all viticultural countries. The sultana is a very vigorous grower and produces well in dry climates under irrigation.

The methods now applied to the cultivation of the sultana vine which have been gained by very long experience, have taught man how to prune and train the vines in order to obtain the desired result. Generally this variety requires long rod pruning, and a number of spurs should be left with the object of controlling the shape as well as producing canes and rods for future cropping. As the first four or five buds on the pruned rod will give very little fruit, to assist the increase in crop it is necessary to control the vine during the growing period, and this is directed towards the production of a rod carrying more fertile buds. The sultana vine when well grown has a tendency to abnormal length of growth, and if unchecked, the fruit buds are often found well out from the main stem of the vine. In order to check any waste energy a system of tipping the terminal of the shoots required for next season's pruning wood should be carried out.

Summer pruning or topping is a much disputed operation which, however, at least in some cases is of great importance. The principal object is to force a way injures the vine: the sap is checked in its flow for a few days only, and within the ordinary pruning radius along the selected pruning rod. This checking in no way injures the vine: the sap is checked in its flow for a few days only, and within a week the new side shoots (laterals) make their appearance. The prevention of elongation should be carried out when the required rod or cane is between 2 to 4 feet in length, according to the vigour of the vine. Drastic and deep cutting and removing of green functioning leaves means injury to the plant. Always bear in mind the principle involved is tipping of the terminal end of the canes, and, therefore, check any tendency of waste energy.

The following varieties should be spur pruned to produce and keep up the quality of the fruit—all muscatel varieties, viz., Gordo Blanco, Frontignac, Red

Muscatel, Muscat Hamburg, Muscat Alexandria, Madresfield Court, Black Muscat, Cannon Hall Muscat, Royal Muscadine, Wortley Hall, Red and Black Malaga, Santa Paula, Gros Colman, Sweet Water, Grand Turk, Trebbiano, Valencia, Doradillo, Chasselas, Black Hamburg, Red Prince, Red May, Aramon, Grenache, Reisling, Matara, Malbec, Burgundy, Pedro Ximenes, Blue Imperial, Zante Currants, Early Madeline.

The following varieties respond well to rod and spur pruning—Shiraz, Malbec, Carbernet, Pinot, Sultana, Black Prince, Ohanez (Almeria), Waltham Cross, Lady's Finger, Flame Tokay, Knight's Centennial, Black St. Peter, Grand Turk, and Purple Cornichon.

In this article only the general principles of pruning are set out, as it is impossible to enter into details, success in pruning only being gained by practical experience.

SMALL FARM WOOL-PRESS.

H. McCallum,
Sheep and Wool Inspector, Department of Agriculture.

Set out below are specifications for the construction of a small farm wool-press which will be of interest to farmers whose flocks are not sufficiently large to warrant the purchase of an expensive press:—

Material required:—

Two sides, each 4ft. 6in. x 2ft. 5in.
Two sides, each 4ft. 6in. x 2ft. 3in.
(suggest 6in. x 1in. hardwood).
Eight chocks, each 2ft. 11in. x 3in. x 2in. hardwood.
12 staples—No. 8 fencing wire
4 skewers—No. 6 fencing wire
(sharpened at one end).

Construction.—The sides are placed in position and the chocks bolted where they cross at the corners. For the staples small holes are bored 2 inches from the top and the wire driven through and turned up inside. This forms a container with sides 2 ft. 3in. square (inside measurements) by 4ft. 6in. high and will turn out neat bales of between 2cwt. and 3 cwt.

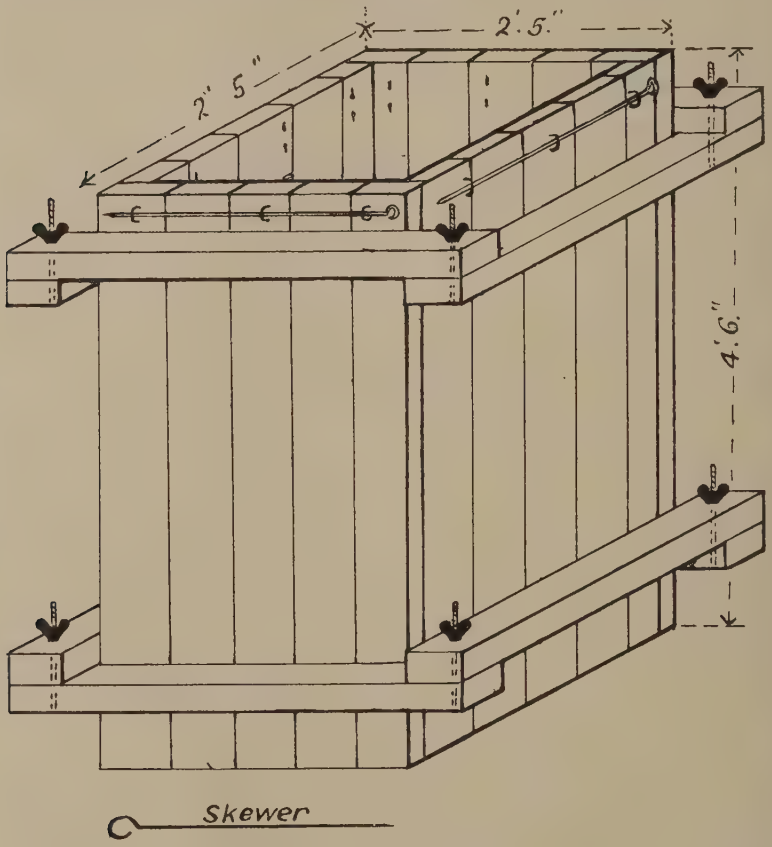
Packing.—The wool-pack (4ft. 6in. x 2ft. 3in. square) is put into the wooden frame, with the corners about 4 inches from the floor and the centre bottom of the pack touching the floor, and is held by running the skewers through the pack, then the staple, then the pack and so on, so that no cutting of the pack is necessary.

The wool must be well pressed or tramped in carefully, filling in the corners first. If this is not done it will be impossible to obtain a square and neatly finished bale.

When the packing is completed, the skewers are withdrawn, the cap is pulled over (the slack being neatly tucked under) and drawn tightly with the centre four-ply stitch.

Two bolts can then be knocked out and the bale released and neatly sewn up or fastened with bale fasteners.

When the pressing and baling is completed it is advisable to immediately brand the packs so that no mistakes will be made in describing the contents.



THE CULTIVATION OF THE PASSION FRUIT.

G. B. Barnett,
Tropical Adviser, Dept. of Agriculture.

The possibilities of the profitable cultivation of Passion Fruit in Western Australia, and particularly in the Northern portions, are very encouraging, providing methodical cultural practices are adopted. Owing to the geographical position of the Northern districts and the comparatively mild winter, passion fruit should be ready for harvesting in November and December—a time when the metropolitan markets are bare of this fruit, as when grown in the Southern areas the passion fruit does not mature until Christmas time or early in the new year.

SELECTION OF SOIL.

The passion vine thrives best on a well-drained, rich, sandy loam, but it can be grown on a wide range of soils with the aid of manures and providing the soil is not liable to become waterlogged. Protection from frosts and boisterous winds should always be provided.

PREPARATION OF THE SOIL.

It is of very great importance that the land should be thoroughly prepared prior to planting. As far as possible, all roots of the original native trees should be removed so as to minimise the attack of white ants. The soil should be ploughed and the surface reduced to a good tilth. If the soil is sour or so heavy that tillage is difficult, an application of lime, say half a ton to one ton per acre, will prove of advantage if applied after the first ploughing.

RAISING YOUNG PLANTS.

As most districts in Western Australia appear to be quite free of the major passion vine diseases and pests, it is essential that every precaution should be taken to prevent their introduction. With this object in view, growers are strongly advised to refrain from introducing seed, and particularly plants, of doubtful origin. It is advantageous, therefore, for the prospective grower to raise his own seedlings in preference to purchasing them. He then has a wider selection in order to secure the more robust plants, and to thus develop an even and vigorous block of vines. It is frequently stated that this practice has had poor results, but, provided the methods recommended are adopted, little difficulty should be experienced in obtaining a good germination and robust plants.

Seed from fruit of good size and quality (i.e., fruit with hard shell and possessing fullness of pulp) and from vines which are known to be heavy croppers should be selected. Selection should not be on the basis of large size only, for frequently the large fruit are found to possess sparseness of pulp and to have been produced from light bearing vines. To raise young vines from such seed is to incur the risk of having vines which produce light crops and fruit of low pulp quality.

The fruit, after selection, may be allowed to dry out or shrivel and the shell can then be crushed in the hand and the seed extracted. If it is desired to hold the seed for any length of time, the fresh pulp should be removed from the ripe fruit, spread out and allowed to dry. Some growers prefer to wash the seed in water prior to drying, but by so doing it is probable that the thin film surrounding the seeds may be removed and the germinating quality reduced. After

drying, the seed should be stored in bottles or tins in a dry cool place, and if likely to be kept for any length of time should be fumigated with carbon bisulphide.

The seed should be planted in well drained, free working, and fertile soil in beds or boxes protected from the severe rays of the sun by hessian or other screens, in rows about eight to twelve inches apart and about half an inch deep in the soil. The seed should be pressed firmly into the soil, and, after being covered loosely with soil, a light coating of old manure may be sprinkled over the surface to act as a mulch. After planting, the bed should receive a thorough but not excessive watering and the soil kept continually moist. The seed should commence to germinate about the fourth or fifth week and, as the seedlings develop, thinning out should take place, allowing one plant to about every four to six inches. Retain only the best sturdy dark green plants. Pale green ones and "runts" cannot be expected to develop into highly productive vines.

PLANTING OUT.

The plants are ready to be removed to their permanent positions when eight inches high. If, for any reason, planting out is delayed and vines obtain several feet of growth, it is advisable to cut the vines back to within about eight inches of the ground prior to removal from the seed bed. Every care should be taken to avoid disturbing the tender roots or soil at time of removal, and as much soil as possible should accompany the seedling. This can be greatly aided by giving the seedlings a thorough watering a few hours before removal. Transplanting should be done as far as possible during the cooler part of the day, i.e., in the afternoon.

TIME OF PLANTING.

Although the passion vine can be planted at practically any time of the year, it is recommended that early spring or autumn planting be adopted; the former for preference. By planting seed in the late summer, the resulting seedlings should be in suitable condition for planting out in early spring.

LAYING OUT THE LAND.

Prior to planting out the vines, the land should be laid out to enable them to be planted in rows eight feet apart with the vines spaced at intervals of 15 to 18 feet in the row. Where possible, the rows should run in a northerly and southerly direction so that as much sunlight as possible will penetrate the vines. Where irrigation is to be practised, water furrows or basins should be made along the proposed row of vines. Suitable holes should be dug for the vines and filled in, taking care that the surface soil is replaced in the last eight inches of top soil. Avoid placing any fresh organic manures in the holes, but well-rotted manure or leaf mould will be of benefit to the young vines.

ERECTION OF SUITABLE TRELLIS.

Many and varied are the methods adopted for training the vines. All of these have advantages and possible disadvantages, but it is likely the most popular in the Eastern States will prove quite suitable for Western Australian conditions.

The trellis should be erected along the proposed row of vines and should consist of good solid posts placed about every 15 to 18 feet apart. They should be eight feet long and about eight inches thick and placed two feet in the ground. The end posts of each trellis should be extra heavy and securely strutted, for,

when the vines are bearing, an enormous strain is placed on these end posts. Two No. 8 or No. 10 wires are attached about three inches from the top of the

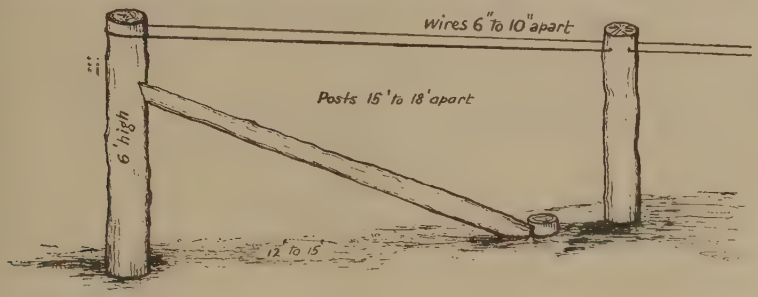


Fig 1

end posts, one on each side, so that when in position the two wires should be parallel and eight inches apart (see Fig. 1). The two wires should be strained tight and attached to each post in the row either by staples or laced to the posts

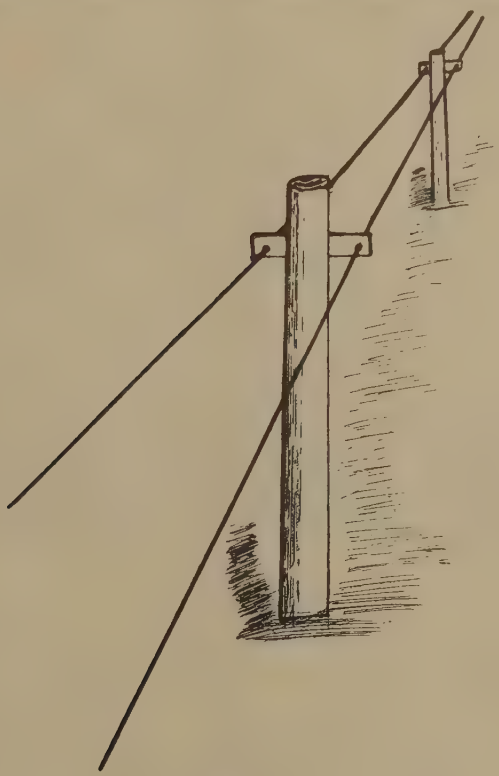


Fig. 2.

with tie wire. Where posts sufficiently wire are obtainable, the wires may be run through holes bored eight inches apart in the posts. If posts less than eight inches wide only are available, 10-inch battens may be attached firmly to the tops of the posts and the wires run through holes in them (see Fig. 2).

TRAINING THE YOUNG VINE.

As previously mentioned, the plants should be placed in their permanent positions during the cool afternoon and should be immediately watered but without submerging the foliage.

Under irrigation conditions, rational irrigation should be adopted until the vines are well established. The number of times the vines will need irrigating will depend greatly on the size of holes, furrows or basins, soil and weather conditions, but providing the soil has good drainage, the risk of over-watering is not likely to be great.

The vines should be placed midway between the posts, right under the wires, and a light stake provided beside the young vine and attached to the two parallel wires. The vine should be trained up the stake by tying the main growth to it as six or eight inches of growth is made. All side shoots should be pinched out as they appear, until the vine has reached the wire, when the terminal growth should be nipped off and the last four side shoots allowed to develop (Fig. 3).

Fig. 3.
A young vine trained on to the parallel wire or horizontal trellis.

These in turn should be trained along the wires, two to the left and two to the right. When removing the side growth from the main stem avoid removing leaves which are attached to the main stem, as these leaves assist greatly in shading the young stem. When the laterals which have been trained along the wires reach the similar growth on the adjacent vine, the terminal growth should be cut off. By doing this, the lateral growth will develop more readily, and it is upon this growth that the major portion of the crop will be carried.

PRUNING.

There is no definite system to follow in the pruning of the passion vine. Suffice it to say that after the summer crop has been harvested, the vines should receive a reasonable amount of attention in that the old bearing fruit wood or laterals should be cut back to suitable sublateral shoots. It is inadvisable to cut back to a dormant eye, for seldom will such a bud burst and form suitable fruiting wood. When too many laterals have developed, they may be thinned out and some of those remaining, shortened back to suitable sublateral growths to within 12 or 15 inches of the wires. No lateral growth should be left close to the ground, as the succeeding growth will trail on the ground, and fruit borne on this growth will be blemished and rendered unsuitable for market.

MANURING.

At planting time two satisfactory methods of manuring may be adopted. The first is to apply superphosphate at the rate of half a pound per vine, well mixed with the soil, so that none of the fertiliser can come in direct contact with the roots. Three to four weeks after planting, the vine should be top-dressed with two ounces of sulphate of ammonia, and this top-dressing may be repeated as required should the vine fail to continue making vigorous growth.

The second method is to apply a mixture of superphosphate and blood and bone in equal parts at the rate of half a pound of each per vine. When this plan is adopted the nitrogen supplied by the sulphate of ammonia in the first method is supplied by the blood and bone, and hence there is no need for top-dressing within the first month as recommended in that plan.

It is necessary to emphasise that the fertilisers in both cases must be thoroughly mixed with the soil so that they do not come in direct contact with the roots when the vine is planted.

As a basic part of any subsequent manuring practice, it is strongly recommended that, in accordance with general orchard practice, some kind of cover crop such as cow peas, vetches, Jerusalem pea, etc., be planted in the most suitable season according to the locality in which the crop is grown. The seed of the cover crop should be planted in drills, and the resulting crop turned under when in full bloom, and then as it rots, the humus destroyed by cultivation will be replaced and also the nitrogen removed by the fruit and vines.

To ensure a maximum growth of the cover crops, it will be necessary in most soils in Western Australia to apply 2 cwt. of superphosphate per acre. With this should be added 2 cwt. of muriate of potash in order to replace the potash removed by the fruit. This is equivalent to eight ounces each of superphosphate and muriate of potash per vine, but it is best applied broadcast so that the cover crop can obtain full benefit from it. As some commercial fertilisers have an injurious effect on the vitality of seeds, they should not be applied directly with the seed of the cover crop.

Most of the nitrogen required by the passion vines will be provided by the decaying cover crop, but the amount available during decomposition may not be sufficient to meet the demands of the quickly growing fruit, and therefore a top-dressing of sulphate of ammonia at the rate of half a pound per vine should be broadcast both in the spring and in the autumn. Sulphate of ammonia is recommended on account of its comparative cheapness, but blood, 13 ounces, blood and bone, 30 ounces, or nitrate of soda, 11 ounces, can be used instead of this provided their respective prices are favourable.

The manurial programme recommended is based upon the requirements of the bearing passion vine, which were estimated by Guthrie* to be—

Nitrogen	6¼ ozs.
Phosphoric acid	1½ ozs.
Potash	4 ozs.

The amount of superphosphate recommended is in excess of the estimated needs of the bearing plant, but this is because of the special requirements of Western Australian soils for phosphoric acid and, in consequence, the need for liberal applications of superphosphate in order to remedy this deficiency, and in order to stimulate the growth of the cover crops so as to produce maximum yields.

The quantity of fertiliser will require to be increased if very heavy crops are produced, and on soils relatively low in fertility the fertiliser recommended for application at planting time will require to be increased and probably supplemented by the addition of a potash fertiliser in order to remedy natural deficiencies in the soil.

It is impossible to exaggerate the importance of growing these cover crops. Not only do these crops collect nitrogen from the air for the use of the passion vine, but they also maintain the supply of organic matter in the soil. Unless this be done its physical character will deteriorate and the maximum response to commercial fertilisers will not be achieved.

CROPPING.

The vines should carry a light crop about eight months after planting, and full bearing should be reached in approximately 18 months from planting.

Two main crops a year can usually be expected, namely summer and winter. The former should prove the most profitable crop for Northern growers in that they should be able to mature their crop in November and December, catching the previously mentioned empty Perth market.

The less handling of the fruit at harvesting time the better, as the fruit is very easily blemished. It should be picked from the vine when coloured and packed for market with the fruit stalk attached, otherwise the keeping quality of the fruit will be poor. Honest grading to size and careful packing will repay the grower.

DISEASES.

As already mentioned, the Northern district is apparently free from disease, but perhaps a few notes on the major diseases affecting the vine in other countries, may assist the grower to detect disease if such should develop.

Brown Spot fungus attacks the leaves, stem, and fruit. The first indication of infection on the leaves is the formation of small brown spots which later may develop a lighter-coloured central area, and expand to a circular blotch of one inch in diameter. On the stem, dark brown elongated spots appear which may extend right round the stem, obstructing the sap flow and causing the foliage to wither and die. Dark green, water-soaked blotches appear on the fruit, and as they enlarge they become brownish in the centre, which causes a sinking of the affected area. Eventually the fruit shrivels and falls (Figs. 4 and 5). This disease is most apparent during humid summer weather conditions. The disease can be controlled by spraying the vines with Bordeaux Mixture 6:4:50 at monthly of two-monthly intervals as required, combined with judicious pruning to allow adequate light and air circulation through the vine.

* "Manures for Passion Vines"—Agric. Gaz., N.S.W., Vol. XV., March, 1903.

Fig. 4.
Vine sprayed with Bordeaux Mixture to prevent Brown Spot infection.

Fig. 5.
Vine in next trellis to vine depicted in Fig. 4. Note defoliation and dropping of fruit caused by Brown Spot infection.

Bullet or Woodiness (a virus disease) can only be controlled by the destruction of infected vines. Symptoms of the disease are that the skin of the fruit becomes abnormally hard and thick, the skin at times cracks, and the fruit contains only a small amount of pulp. The vine itself shows a stunted and deteriorated appearance, and the foliage is curled and twisted. This latter symptom is very apparent in the terminal growth.

OAT VARIETY TRIALS.

H. G. ELLIOTT,
Agricultural Adviser, Dairy Branch.

Oat variety trials have been conducted in the South-West for a number of years by officers of the Dairy Branch and were continued during 1933.

At Denmark the experiments were conducted on the Denmark Experiment Farm.

Soil: Gravelly loam.

Cultivation: Land fallowed, cultivated, harrowed, and sown at end of May.

Rate of Seeding: 2 bushels per acre.

Fertiliser: 1½ cwts. superphosphate per acre.

The yields were as follow:—

Variety.	Yield.	Percentage Yield Hay.
	tons cwt. qrs. lb.	
Algerian Oats	2 3 2 2	100
Guyra Oats	1 17 0 24	85
Burt's Early Oats	1 11 3 7	71
Mulga Oats	1 10 2 12	70
*Yandilla King Wheat	1 15 0 12	80

*This variety of Wheat was included in the trials this year.

Experiments conducted on the property of Mr. Barton Langridge, Donnybrook:—

Rate of seeding: 2 bushels per acre.

Fertiliser: 1½ cwts. per acre.

The yields were as follow:—

Variety.	Yield.	Percentage Yield Hay.
	tons cwt. qrs. lb.	
Algerian Oats	1 10 0 0	100
Guyra Oats	1 5 0 0	83
Burt's Early Oats	1 15 0 0	117
Mulga Oats	2 5 0 0	150

The average of the 28 trials conducted throughout the South-West are shown in the following table:—

Variety.	Yield. Average 74 Plots = 28 Trials.	Percentage Yield Hay.
	tons cwt. qrs. lb.	
Algerian Oats	2 8 1 11	100
Guyra Oats	2 3 2 22	90
*Lachlan Oats	2 2 0 7	87
Burt's Early Oats	1 15 2 17	74
Mulga Oats	1 15 1 25	73

* Lachlan: 20 plots only.

COUCH GRASS MITE.

Eriophyes tenuis.? (*Nelepa*).

L. J. NEWMAN, F.R.E.S., Government Entomologist.

During the past few years it has become increasingly difficult to maintain a consistently healthy growth of couch grass in many bowling greens, tennis courts and home lawns. Patches have appeared in the lawns, which refused to respond to manurial treatment. The grass failed to make runners, growing only in tufts, and also assumed a sickly appearance. This proved not only disappointing and unsightly, but in the case of lawns used for tennis, bowls, or other games, it seriously affected the playing surface. Many inquiries have been received as to the cause of the trouble, and considerable research has been undertaken by the Pathologist, Agrostologist, and Entomologist.

It was thought that the trouble might be due to under manuring, the use of wrong fertilisers, excess wear by constant playing of games, or the need of a complete reconditioning of the lawns. It appears that soil fungi have been responsible for a certain amount of grass injury in some cases.

Recently in the continuance of efforts to arrive at the causative factor, a microscopic mite was discovered. It is definitely believed that this mite is responsible for much of the patchiness and poverty of growth sometimes found in couch grass lawns. The mite has been recorded from widely separated places, namely, Geraldton, Northam, and the metropolitan area, and no doubt can be found in many other parts of the State.

Mites are not true insects, but belong to the invertebrate animals, known as the Arthropoda and to the order *Acarina*. They are related to spiders and ticks. Though not true insects, they are often serious pests in the garden, and in some instances are a serious annoyance to animals and humans.

They are distinguished from insects in the numbers and structure of their legs; while insects only have six legs and are known as hexapods, mites, according to their species, may possess four, six, or eight legs. In the species here referred to as the Couch Grass Mite, there are only four legs, situated near the head.

This mite belongs to the family of mites known as the *Eriophyidae* and to the genus *Eriophyes*. Its specific name is probably *Eriophyes tenuis*. It is known to

exist in European countries, where it attacks several species of grasses. The members of this family are all so minute that they can only be studied with the aid of a high power microscope; they cannot be discerned with the naked eye. The *Eriophyidae* are amongst the most curious of the *Acarina*. They make up for their lack of size by their great numbers and are strictly plant feeders, many species causing galls (such as our common Pear Leaf "Blister" Mite), fuzzy spots or other deformations on plants.

The mite under discussion is one one-hundred-and-fiftieth of an inch long, is of a greyish white colour and semi opaque. As before stated there are but four legs, situated near the head. At the tip of the abdomen is an anal sucker, which

Figs. 1 and 2. Greatly enlarged. After Tucker.

Pear Leaf Blister Mite, *Eriophyes pyri*. Back and side view. The Couch Grass Mite is closely related and in general appearance is very similar.

aids the mite in holding on to a surface but does not assist in locomotion. The mite appears to be able to move rapidly over the plant surface. The abdominal segment of the body has a number of rings or annulations, giving the impression of corrugation, and there are a few hairs scattered in pairs here and there. (Figures 1 and 2.) The eggs are circular transparent bodies, laid separately in sheltered positions upon the surface of the leaf. They are quite large as compared with the mite which lays them.

In examining the infested grass, the mites were found in large numbers attacking the buds within the axils of the leaves, resulting in a bunching of the leafy shoots, so that the plants instead of making runners and spreading in the normal way, produce a proliferation or several buds from the affected points, imparting to the whole a bunching or tufting effect, a growth which is characteristic of injury caused by the mite. (Figure 3.)

Couch Grass, showing typical proliferation and bunchy growth produced by mite attack. Note the lack of lateral runners.

In samples which appear to be more seriously affected, something akin to a fasciation is produced, so that more or less flattened or abbreviated stems are formed producing opposite rows of scale-like leaves, somewhat resembling small heads of barley.

Any such appearance in a couch lawn should be suspected of being caused by this mite.

Treatment Recommended.—Select a fine period of bright weather and closely mow the lawn. (See that all the grass so removed is destroyed by fire.) Follow the cutting with a thorough spraying with one of the proprietary lime and sulphur washes, using at a strength of 1 part to 60 parts of water. Apply with coarse nozzle, making sure that the spray is forced well down into the grass. It will serve little purpose if merely applied as a fine atomised mist to the surface of the grass.

As numerous eggs are always present and these are not readily destroyed by the spraying, a second application of the spray to the infested portions of the lawn should be made three weeks later, after being mowed.

The grass, after treatment, should be stimulated to growth by dressing with suitable lawn fertiliser such as sulphate of ammonia, nitrate of soda, or special lawn manures.

No doubt this mite, like other closely related species, would succumb to any contact spray or dust, the secret of success being in the bringing of the spray or dust into contact with the mite. To do this necessitates thoroughness of application.

Wherever tufty or infested grass can be pulled up, this should be carefully done and destroyed by fire.

For the naming of the mite, I am indebted to Mr. H. Womersley, Entomologist, South Australia.

AGRICULTURAL PROBLEMS.

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district or the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in air-tight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

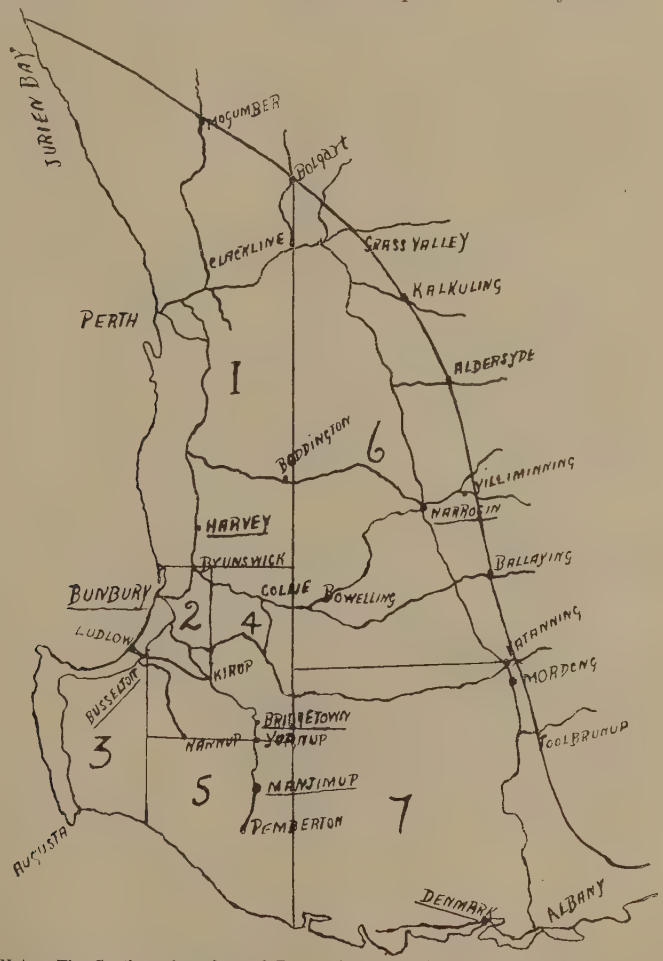
The addresses and names of Advisers are as follows:—Albany, A. C. Vaughan; Bridgetown, A. Flintoff; Bunbury, M. Cullity; Denmark, V. Cardon; Geraldton, G. L. Throssell, Government Buildings; Gosnells, R. C. Owen; Harvey, D. L. Breen (Fruit) and C. Giles (Dairying); Katanning, A. S. Wild; Manjimup, J. Ireland; Mundaring, V. Cahill; Northam, F. L. Shier; Northcliffe, A. Sharp; Vasse, J. M. Nelson.

THE BETTER DAIRYING COMPETITION.

1934.

G. K. Baron-Hay,
Superintendent of Dairying.

The Better Dairying Competition, which was inaugurated in 1932 by the West Australian Committee of the Australian Dairy Council with the main object of inducing farmers to increase the fodder available for their dairy stock, proved so valuable that it was decided to continue the competition for the year 1934.



Note.—The Southern boundary of Zone 6 is now a direct line through Mt. Barker.

As in previous years, judging was carried out by officers of the Dairy Branch, Department of Agriculture, the South-West portion of the State being divided into

seven zones as shown in the accompanying map, arranged as far as possible according to climatic and soil conditions (see map).

Farms were judged according to the attached scale of points, which had been slightly altered from that of previous years, so as to stress still further the value of fodder and its conservation.

The following handicaps also were imposed on those competitors who gained prizes during the previous year:—

First Prize winner	...	...	...	Deduct	15	points.
Second " "	...	...	...	"	10	"
Third " "	...	...	...	"	5	"
Fourth " "	...	...	...	"	1	"

As in previous competitions, the advice of Mr. P. Rose, of Burekup, was of special value in framing the schedule of points for judging.

1.—Shield donated by Cuming Smith Mt. Lyell Farmers' Fertiliser Co. To be held by the zone containing the four leading farmers.

CHAMPION DISTRICT SHIELD.

This handsome shield, donated by Messrs. Cuming, Smith & Mt. Lyell Farmers' Fertilisers, Ltd., is awarded annually to that district or zone containing the four leading farms.

For the season 1932-33 the shield was won by No. 2 Zone, controlled by the Wellington Agricultural Society, Bunbury, the four leading farms being owned by:—

H. Noon, Katterup
Percy Rose, "Yeralla," Burekup
Norton Bros., Capel
J. Hearman, Donnybrook

The results for 1934 season are not yet available.

The main headings under which competitors were judged and points allotted were as follow:—

	Max. Points.
1. Conservation of Fodder and Summer Fodder Crops (300 points)—	
(a) *Hay*—Quality, Condition	60
(b) *Silage*—Quality, Type, Wastage, etc.	60
(c) *Summer Fodder Crops*—Cultivation, Disease, Yield ...	50
(d) Amount conserved per cow	130
2. Pastures (200 points)—	
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150
(b) Management, Fertilisation	50
3. Dairy Herd (160 points)—	
(a) Breeding	50
(b) Dairy Type	50
(c) Condition and Freedom from Disease	30
(d) Herd Sire—(i) Pure-bred	20
(ii.) Ex tested Dam	10
4. Returns per Acre (120 points)—	
(a) Butter Fat.....lb. per acre	100
*Sidelines £.....per acre	20
5. Pigs (30 points)—	
(a) Breed, Type, and Condition	10
(b) No. of breeding Sows in proportion to milch Cows ...	10
(c) Housing, Feeding and Management	10
6. Farm Management (140 points)—	
(a) Lay-out, Convenience, etc.	50
(b) Sanitation: (i) General	30
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40
(c) Book-keeping and Records	20
7. Utilisation of Skim Milk (50 points)—	
Based on number of pigs reared and calf-months per cow ... (5 months—1 calf—1 pig)	50
Total	1000

* Pigs Poultry, Vegetables, etc.

A perusal of the above schedule will show the great importance attached to pasture, fodder crops, and fodder conservation by the Committee, as 500 from a total of 1,000 points were allotted for these items.

Owing to the large area covered by the competition, which provided varying climatic and seasonal conditions with annual rainfalls ranging from 20 to 70 inches, it was found necessary to judge the farms in zones at different periods of the year, as follows:—

Zone 1	—Centre	Harvey	Jan. 15th to Feb. 15th, 1934
Zone 2	„	Bunbury	Jan. 1st to Jan. 30th, 1934
Zone 3	„	Margaret River ...	Feb. 1st to Feb. 28th, 1934
Zone 4	„	Bridgetown	Jan. 15th to Feb. 15th, 1934
Zone 5	„	Manjimup	Jan. 15th to Feb. 28th, 1934
Zone 6	„	Narrogin	Jan. 1st to Jan. 30th, 1934
Zone 7	„	Denmark	Feb. 1st to 28th, 1934

Prizes as follow were generously donated by the Committee of the Australian Dairy Council:—

First Prize in each Zone	... ...	£10 and framed Certificate
Second ,, ,, ,,	... ...	£6
Third ,, ,, ,,	... ...	£4
Fourth ,, ,, ,,	... ...	£3

The following tables, 1 to 7, set out in detail the points obtained by each competitor in the various zones.

TABLE 1.—POINTS GAINED BY COMPETITORS IN ZONE 1.

CENTRE: HARVEY AGRICULTURAL SOCIETY.

Judge: H. G. Elliott, Agricultural Adviser, Dairy Branch.

	Maximum Points	S. F. Russell.	W. Shaw.	G. E. Scott.	S. Bowers.	T. Briggs.	C. H. Peterson.	Bee Bros.	A. Warburton.	A. E. Clifton.	F. S. Morris.	L. Temple.
1. Conservation of Fodder and Summer Fodder Crops (300 points)–												
(a) *Hay*—Quality, Condition	60	55	56	51	55	51	54	51	53	51	53	...
(b) *Silage*—Quality, Type, Wastage, etc.	60	*50	*57	*50	55	52	56	53	*30	51	*35	*48
(c) *Summer Fodder Crops*—Cultivation, Disease, Yield	50	48	48	43	38	45	45	36	42	36	42	40
(d) Amount conserved per cow	130	130	130	130	120	120	120	99	130	104	130	80
2. Pastures (200 points)—												
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150	137	146	141	131	133	132	129	131	126	130	138
(b) Management, Fertilisation	50	47	47	38	40	42	42	37	40	35	36	45
3. Dairy Herd (160 points) –												
(a) Breeding	50	44	42	47	43	45	44	46	41	41	40	45
(b) Dairy Type	50	46	46	47	44	44	45	46	43	41	41	46
(c) Condition and Freedom from Disease	30	28	29	29	25	27	24	27	25	24	24	25
(d) Herd Sire: (i) Pure-bred...	20	20	19	20	18	20	17	20	17	17	17	20
(ii) Ex tested Dam	10	...	7	8	4	7	...	10	8	...	...	...
4. Returns per Acre (120 points)—												
(a) Butter Fat, per acre ...	100	87	73	91	78	51	58	78	77	68	61	76
Sidelines (Pigs, Poultry, Vegetables, etc.), per acre ...	20	20	20	5	20	18	10	5	12	20	16	12
5. Pigs (30 points)—												
(a) Breed, Type, and Condition	10	...	...	...	...	8	...	...	...	...	...	8
(b) No. of breeding Sows in proportion to milch Cows	10	†15	†15	†15	†15	5	†15	†15	†15	†15	†15	7
(c) Housing, Feeding, and Management	10	...	...	...	...	7	...	...	...	...	...	8
6. Farm Management (140 points)—												
(a) Lay-out, Convenience, etc.	50	47	44	38	38	44	39	43	43	39	40	46
(b) Sanitation:												
(i) General	30	28	24	25	26	24	24	25	23	22	22	26
(ii) Milking Shed, Dairy, Dairy Utensils and care of Cream and Milk	40	36	31	36	36	34	35	36	33	32	32	33
(c) Book-keeping and Records	20	17	13	14	15	14	12	12	13	11	10	17
7. Utilisation of Skim Milk (50 points)—												
Based on number of pigs reared and calf-months per cow ... (5 months – 1 calf – 1 pig)	50	13	4	13	24	30	16	20	11	47	27	50
Total	1,000	868	851	841	825	821	798	788	787	780	771	770
Handicap ...	...	—15	...	...	—1	—10	...	...	...	...	...	...
Total	...	853	851	841	824	811	798	788	787	780	771	770

* No silage, but irrigated pastures and summer fodders. † Whole milk suppliers. Pigs only kept during flush period.

2.—"Tipperary" Stud of Australian Illawarra Shorthorns.

The above herd, owned by the winner in Zone 6 (Narrogin), Mr. W. G. Burges. Twenty cows completing test averaged 9,146.1 lbs. Milk and 368.9 lbs. Fat in 1933-34.

TABLE 2.—POINTS GAINED BY COMPETITORS IN ZONE 2.

CENTRE: BUNBURY AGRICULTURAL SOCIETY. Judge: C. Giles, Dairy Instructor, Dairy Branch.

	Maximum Points.	P. Rose.	Flanagan Bros.	A. Trigwell.	A. Frost.	W. J. Sears.	Norton Bros.	Dunkley Bros.	R. J. Trigwell.	J. Hearman.	W. W. Hutton.	E. Fitzgerald.
1. Conservation of Fodder and Summer Fodder Crops (300 points)—												
(a) *Hay*—Quality, Condition	60	52	50			46				42		
(b) *Silage*—Quality, Type, Wastage, etc.	60	25	55	78	85	45	132	145	120	48	100	...
(c) *Summer Fodder Crops*—Cultivation, Disease, Yield	50	40	30			25				30		
(d) Amount conserved per cow	130	104	47	77	64	104	30	32	100	130	16	...
2. Pastures (200 points)—												
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150	110	125	100	120	105	120	118	106	105	100	100
(b) Management, Fertilisation	50	44	42	40	40	42	32	30	42	35	36	35
3. Dairy Herd (160 points)—												
(a) Breeding	50	50	43	44	44	30	42	43	38	40	40	30
(b) Dairy Type	50	46	41	45	42	38	41	44	32	32	42	42
(c) Condition and Freedom from Disease	30	27	24	25	27	24	23	25	27	18	22	25
(d) Herd Sire: (i) Pure-bred	20	20	20	20	20	18	18	20	20	17	15	20
(ii) Ex tested Dam	10	10	...	...	...	10	10	8	...	10	10	...
4. Returns per Acre (120 points)—												
(a) Butter Fat, per acre	100	49	53	100	100	52	64	49	15	25	31	64
Sidelines (Pigs, Poultry, Vegetables, etc.), per acre	20	6	20	20	12	9	9	5	7	9	11	7
5. Pigs (30 points)—												
(a) Breed, Type and Condition	10	7	8	8	8	8	7	8	9	7	8	...
(b) No. of breeding Sows in proportion to milch cows	10	10	4	7	10	3	3	6	10	5	...	...
(c) Housing, Feeding, and Management	10	8	9	7	8	7	6	9	9	5	6	...
6. Farm Management (140 points)—												
(a) Lay-out, Convenience, etc.	50	45	45	38	40	41	40	35	42	35	48	35
(b) Sanitation:												
(i) General	30	28	28	22	24	25	25	22	26	25	28	22
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40	35	36	28	32	30	32	28	32	30	36	30
(c) Book-keeping and Records	20	20	18	15	16	15	18	18	14	15	17	10
7. Utilisation of Skim Milk (50 points)—												
Based on number of pigs reared and calf-months per cow (5 months—1 calf—1 pig)	50	50	30	50	29	30	50	50	50	16	43	22
Total	1000	786	728	724	721	707	702	695	693	678	604	442
Handicap	...	—10	...	...	...	...	—5	...	...	—1	...	...
Total	...	776	728	724	721	707	697	695	693	677	604	442

TABLE 3.—POINTS GAINED BY COMPETITORS IN ZONE 3.
CENTRE: BUSSELTON AGRICULTURAL SOCIETY.
Judge: J. M. Nelson, Dairy Supervisor, Dairy Branch.

	Max. Points.	A. Millar.	C. H. Ironmonger.	C. Casselton	M. Torrent.	J. W. Oldfield.	A. Wilkinson.	A. W. Langley.	A. White.	J. J. Burge.	C. Taylor.	J. Illesley.	G. Smith.	A. Piele.	H. Johnson.	W. J. Johnson	J. Angell.	T. Buller.	W. Key.	W. Beecham.
1. Conservation of Fodder and Summer Fodder Crops (300 points)—																				
(a) *Hay*—Quality, Condition	60	40	43	50	45	45	50	45	50	55	45	48	46	45	43	47	47	55	40	45
(b) *Silage*—Quality, Type, Wastage, etc. ...	60	36	45	...	...	55	...	45	45	50	...	...	...	...	52	40	...	...	45	...
(c) *Summer Fodder Crops*—Cultivation, Disease, Yield	50	35	30	45	43	...	30	...	30	40	...	38	...	45	...	30	...	...	...	35
(d) Amount conserved per cow	130	124	125	123	114	128	112	117	120	119	122	114	125	116	118	118	115	113	120	120
2. Pastures (200 points)—																				
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150	115	110	110	112	110	120	113	100	100	115	100	113	105	95	100	114	115	100	105
(b) Management, Fertilisation	50	40	40	45	40	40	36	40	35	40	40	40	43	40	45	45	40	45	40	45
3. Dairy Herd (160 points)—																				
(a) Breeding	50	40	45	40	38	40	40	40	40	40	40	42	45	42	40	40	42	42	35	40
(b) Dairy Type	50	40	45	42	40	40	43	40	40	42	45	45	45	45	38	40	40	45	38	40
(c) Condition and Freedom from Disease ...	30	27	27	27	26	25	26	27	25	28	25	26	26	26	26	24	26	27	25	25
(d) Herd Sire—(i) Pure-bred	20	18	18	16	8	12	12	10	17	17	12	16	16	16	10	16	16	17	5	10
(ii) Ex tested Dam	10	10	5	8	...	...	...	...	5	5	...	7	5	4	...	5	5	6	...	...
4. Returns per Acre (120 points)—																				
(a) Butter Fat (per acre)	100	74	57	60	99	68	100	94	66	56	87	60	65	49	61	31	74	47	79	55
*Sidelines (per acre)	20	12	...	10	17	14	14	12	5	10	10	10	10	12	12	10	10	12	10	17
5. Pigs (30 points)—																				
(a) Breed, Type, and Condition	10	8	8	8	8	8	8	8	8	5	8	8	8	5	7	8	8	9	8	5
(b) No. of breeding Sows in proportion to milch Cows	10	6	3	8	8	8	5	...	5	...	6	8	3	5	8	7	8	8	5	5
(c) Housing, Feeding and Management ...	10	8	6	7	7	8	8	7	6	8	8	7	8	5	8	7	7	8	7	5
6. Farm Management (140 points)-																				
(a) Lay-out, Convenience, etc.	50	38	35	38	35	46	35	36	35	40	40	40	40	36	40	35	43	35	35	35
(b) Sanitation :																				
(i) General	30	27	25	25	25	28	25	27	23	28	25	25	27	27	25	24	20	28	26	25
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk ...	40	35	36	38	32	35	32	34	35	35	33	36	36	36	36	36	34	36	33	30
(c) Book-keeping and Records	20	12	12	15	15	12	14	12	15	15	18	14	12	17	12	14	15	18	12	15
7. Utilisation of Skim Milk (50 points)— Based on number of pigs reared and calf-months per cow ... ... (5 months—1 calf—1 pig)	50	35	40	25	35	35	36	35	32	30	36	30	36	33	32	30	35	38	30	35
Total	1000	780	755	750	748	747	746	742	737	723	715	714	709	709	708	707	699	694	693	692

* Pigs, Poultry, Vegetables, etc.

3.—Rotational Sowing of Maize for Summer Fodder on Mr. S. F. Russell's Farm, Serpentine. Winner in Zone 1 (Harvey).

TABLE 4.—POINTS GAINED BY COMPETITORS IN ZONE 4.
CENTRE: BRIDGETOWN AGRICULTURAL SOCIETY.
Judge: C. Giles, Dairy Instructor, Dairy Branch.

	Maximum Points.	C. Pearce	H. E. Kendall.	G. E. White.	V. A. Doust.	T. Gibblett.	A. Hayward.	S. C. Maidment.
1. Conservation of Fodder and Summer Fodder Crops (300 points)—								
(a) *Hay*—Quality, Condition	60	}		48	50	}	45	50
(b) *Silage*—Quality, Type, Wastage, etc. ...	60	88	89	42	48	80	42	52
(c) *Summer Fodder Crops*—Cultivation, Disease, Yield	50	...	...	5	...	...	...	...
(d) Amount conserved (per cow)	130	64	77	79	41	39	70	65
2. Pastures (200 points)—								
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc. ...	150	120	100	115	125	120	100	100
(b) Management, Fertilisation	50	46	40	44	45	46	40	42
3. Dairy Herd (160 points)—								
(a) Breeding	50	45	42	42	32	40	42	37
(b) Dairy Type	50	45	42	40	40	42	40	41
(c) Condition and Freedom from Disease ...	30	28	27	26	25	28	25	20
(d) Herd Sire—(i) Pure-bred	20	20	20	20	10	20	18	18
(ii) Ex tested Dam ...	10	10	10	5	...	...	10	...
4. Returns per Acre (120 points)—								
(a) Butter Fat (per acre)	100	48	58	48	56	58	52	34
*Sidelines (per acre)	20	6	12	6	16	15	5	13
5. Pigs (30 points)—								
(a) Breed, Type, and Condition	10	10	8	8	8	5	8	6
(b) No. of breeding Sows in proportion to milch Cows	10	10	...	10	5	5	5	2
(c) Housing, Feeding and Management ...	10	8	7	7	8	5	5	5
6. Farm Management (140 points)—								
(a) Lay-out, Convenience, etc.	50	46	40	42	42	44	35	35
(b) Sanitation:								
(i) General	30	22	22	20	22	25	20	20
(ii) Milking Shed, Dairy, Dairy Utensils and care of Cream and Milk	40	35	35	30	32	35	30	30
(c) Book-keeping and Records	20	18	15	15	16	20	17	17
7. Utilisation of Skim Milk (50 points) Based on number of pigs reared and calf-months per cow ... ... (5 months—1 calf—1 pig)	50	24	33	16	30	25	30	34
Total	1000	693	677	663	656	652	634	621

TABLE 5.—POINTS GAINED BY COMPETITORS IN ZONE 5.

CENTRE: MANJIMUP AGRICULTURAL SOCIETY.

Judge: A. Sharp, Dairy Supervisor, Dairy Branch.

	Maximum Points.	H. C. Barnsby.	G. F. Coombs.	H. Brown.	A. G. Abbott.	S. Gray.	W. Hand.	A. S. Hilditch.	L. Preston.	G. T. N. Downes.	G. Jackson.	H. F. Jay.
1. Conservation of Fodder and Summer Fodder Crops (300 points)—												
(a) *Hay*—Quality, Condition	60	52	35	46	44	40	50	50	42	40	40	45
(b) *Silage*—Quality, Type, Wastage, etc.	60	54	44	55	44	44	52	46	48	50	48	...
(c) *Summer Fodder Crops*—Cultivation, Disease, Yield	50	20	...	20	15	23	...	4	...	12	9	24
(d) Amount conserved per cow	130	125	130	80	100	97	95	125	125	88	106	40
2. Pastures (200 points)—												
(a) Condition, Freedom from Weeds Mixture, Drought-resistance, etc.	150	105	95	100	80	110	90	100	70	80	95	80
(b) Management, Fertilisation	50	40	37	40	46	32	40	40	34	34	38	40
3. Dairy Herd (160 points)—												
(a) Breeding	50	40	50	40	45	36	40	35	45	38	38	38
(b) Dairy Type	50	44	45	42	40	38	38	33	42	36	35	41
(c) Condition and Freedom from Disease	30	26	24	23	23	22	22	19	22	22	21	22
(d) Herd Sire:												
(i) Pure-bred	20	20	20	20	20	18	20	20	20	20	20	20
(ii) Ex tested Dam ...	10	10	10	10	10	...	10	10	10	10	...	10
4. Returns per Acre (120 points)—												
(a) Butter Fat, per acre ...	100	73	71	62	52	76	51	40	41	58	42	76
Sidelines (Pigs, Poultry, Vegetables, etc.), per acre ...	20	16	...	8	3	3	...	...	...	...	...	5
5. Pigs (30 points)—												
(a) Breed, Type, and Condition	10	7	6	5	6	6	5	5	5	2	5	5
(b) No. of breeding Sows in proportion to milch Cows	10	8	5	6	7	4	6	8	4	...	6	8
(c) Housing, Feeding and Management	10	8	7	7	8	7	6	6	7	5	6	6
6. Farm Management (140 points)—												
(a) Lay-out Convenience, etc.	50	36	36	32	45	34	34	32	35	31	31	29
(b) Sanitation:												
(i) General	30	26	25	23	28	24	24	20	24	25	23	21
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40	36	34	34	35	25	34	32	35	32	26	32
(c) Book-keeping and Records	20	16	15	13	12	5	17	2	3	12	4	17
7. Utilisation of Skim Milk (50 points)—												
Based on number of pigs reared and calf-months per cow ... (5 months—1 calf—1 pig)	50	42	33	14	13	13	19	12	11	15	5	15
Total	1000	804	722	680	676	657	653	639	623	610	598	574
Handicap ..	...	15	—1	—5	...	—10	...	...	...	...	...	...
Total	...	789	721	675	676	647	653	639	623	610	598	574

ZONE 6—CENTRE, NARROGIN.

This Zone (see map) embraces land lying either side of the Great Southern Railway from approximately Northam to Kendenup, the rainfall varying from 17 to 25 inches.

Whilst, primarily, this land was considered as suitable for oat growing and the rearing of sheep, the production of butter fat in the district also has more than doubled during the last three years, and those farmers owning cattle have made dairy farming a permanent adjunct to their system of farming.

The most important factor for success with all stock-rearing activities in this Zone is fodder conservation.

The committee, therefore, decided to continue the special competition inaugurated last year, designed specifically to encourage fodder conservation, judging being conducted according to the following scale of points:—

Fodder conserved per head of dairy cows	50	points.
Hay—Quality and condition	50	,,
Silage and/or Summer Fodder Crops	100	,,
Use of Phosphatic Licks	25	,,
Sanitation of Dairy Premises	25	,,
Total	250	,,

Details of the points gained by each competitor are shown in Table 6, winners in the competition last year being handicapped as follows:—

First Prize winner	Deduct 5	points.
Second ,, ,, ...	,, 3	,,
Third ,, ,, ...	,, 1	,,

4.—Giant Jersey Kale grown by C. Candy, Mt. Barker, as Summer Fodder.

TABLE 6.—POINTS GAINED BY COMPETITORS IN ZONE 6.

CENTRE:—NARROGIN AGRICULTURAL SOCIETY.

Judge:—H. G. Elliott, Agricultural Adviser, Dairy Branch.

Competitor.	Handicap.	* Fodder Conserved per Head.	Hay Quality Condition.	Silage.	Summer Fodder Crop.	Use of Phosphatic Lick.	Sanitation of Dairy Premises.	Total Points.
		50.	50.	100.		25.	25.	250.
W. G. Burges ...	— 5	50	48	99	...	25	23	240
E. Loynel	...	46	44	...	90	25	22	227
T. A. Hardie & Son	...	50	47	...	75	25	23	220
R. McDougal ...	...	50	46	...	77	25	21	219
J. L. Williamson ...	...	50	38	85	...	25	20	218
G. Webb	...	40	49	87	...	25	10	211
L. P. James ...	...	38	38	...	96	25	13	210

* Fodder conserved per head based on a conservation of 2½ tons hay and 2 tons of silage or green material per cow.

Where both Silage and Fodder Crops are provided, the scale of points to be halved in these sections, so that their total remains 100.

The necessity for ample fodder reserves for all classes of farm stock apparently is realised by farmers in this Zone—with its natural disability of low rainfall—to a far greater extent than by farmers in areas with heavier rainfalls.

This is shown in the following table, which indicates that in Zone 6 the average conservation of fodder calculated as hay is 5.83 tons per cow, or more than three times that in other Zones. This undoubtedly accounts for the excellent herd productions recorded by leading farmers in this district.

5.—Stack of clover silage built by Langley & Sons, Cowaramup. Estimated to contain 100 tons.

TABLE 7.—FODDER CONSERVED PER COW IN GREAT SOUTHERN DISTRICTS COMPARED WITH AVERAGE FOR SOUTH-WEST ZONES.

	Fodder Reserve per Cow.				Total Reserve calculated as Hay (Tons).*	
	Hay (Tons).		Silage (Tons).			
	1932–33.	1933–34.	1932–33.	1933–34.	1932–33.	1933–34.
Zone 6	2·9	4·9	3·3	2·8	4·00	5·83
Other Zones	1·21	1·49	1·16	0·89	1·60	1·79

* 1 ton hay = 3 tons silage.

During the last two years the competition has shown that meadow hay can be grown in the Great Southern districts having 17 inches of rain. No less than five of the seven competitors had meadow hay on hand, a total of 282 tons being cut on the five properties. The judge, Mr. H. G. Elliott, remarks that the quality of this hay was superior to that seen during the previous year, owing to having been cut earlier in the season.

It is pleasing to note that all competitors were feeding di-calcic phosphatic lick to their stock, as this practice is considered essential to the health of stock throughout the summer months.

TABLE 8.—POINTS GAINED BY COMPETITORS IN ZONE 7.

CENTRE: DENMARK AGRICULTURAL SOCIETY.

Judge: V. A. Cardon, Dairy Supervisor, Dairy Branch.

	Max. Points.	J. J. Daly.	P. Berridge.	S. L. Anning.	A. Smith.
1. Conservation of Fodder and Summer Fodder Crops (300 points)—					
(a) *Hay*—Quality, Condition	60	50	55	50	40
(b) *Silage*—Quality, Type, Wastage, etc.	60	30	40	55	...
(c) *Summer Fodder Crops*—Cultivation, Disease, Yield	50	45	30	*35	30
(d) Amount conserved per Cow	130	120	130	100	90
2. Pastures (200 points)—					
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc. ...	150	120	120	130	100
(b) Management, Fertilisation	50	40	40	40	30
3. Dairy Herd (160 points)—					
(a) Breeding	50	45	40	35	35
(b) Dairy Type	50	40	40	40	35
(c) Condition and Freedom from Disease .	30	28	25	25	20
(d) Herd Sire (i) Pure-bred	20	15	19	18	20
(ii) Ex tested Dam ...	10	...	10	10	10
4. Returns per Acre (120 points)—					
(a) Butter Fat (per acre)	100	90	95	80	100
*Sidelines (per acre)	20	20	8	10	...
5. Pigs (30 points)—					
(a) Breed, Type, and Condition	10	8	8	5	...
(b) No. of breeding Sows in proportion to milch Cows	10	4	6	6	...
(c) Housing, Feeding and Management ...	10	8	7	4	...
6. Farm Management (140 points)—					
(a) Lay-out, Convenience, etc.	50	40	35	35	30
(b) Sanitation:					
(i) General	30	28	28	20	25
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40	38	32	30	25
(c) Book-keeping and Records	20	12	15	10	...
7. Utilisation of Skim Milk (50 points)— Based on number of pigs reared and calf-months per cow ... ... (5 months—1 calf—1 pig)	50	45	40	35	30
Total	1000	826	823	773	620

* Pigs, Poultry, Vegetables, etc.

LESSONS FROM THE COMPETITION.

The Better Dairying Competition has been conducted for three years, and during that period no less than 196 farms have been visited and carefully judged by officers of the Dairy Branch, Department of Agriculture. A perusal and study of the tables below give valuable and, it is believed, accurate information regarding essential factors for success in dairying in Western Australia, and it is remarkable how consistent these factors have been during the three years that the competition has been conducted.

1.—CONSERVATION OF FODDER AND SUMMER CROPS.

Conservation of fodder is believed to be the most important factor in successful stock husbandry in Western Australia, and it is significant throughout the competition that the most successful farmers—not only from the point of view of gaining a place in the competition but from that of being considered sound stockmen—are those with the greatest tonnage of conserved fodder per head of stock.

The object of the Western Australian Committee of the Australian Dairy Council, when initiating the competition, was to interest farmers in permanent pasture production and to conserve greater quantities of fodder for summer consumption, and it is gratifying to note that these objects have been progressively achieved during the last three years.

6.—Second Growth of Cow Peas. S. F. Russell, Serpentine. This summer growing legume has been grown with great success in the South-West.

Table 9 shows the total fodder conserved per cow in each Zone compared with that of the leading competitor.

TABLE 9.—TOTAL FODDER CONSERVED PER COW.

	Cows.	Hay.	Silage.	Reserve per Cow.		Reserve per Cow calculated as Hay.*
				Hay.	Silage.	
		tons.	tons.	tons.	tons.	
Zone 1 (Harvey)—Average ...	379	466	193	1·23	0·51	1·40
C. H. Peterson	22	26	30	1·19	1·37	1·65
Zone 2 (Bunbury)—Average ...	396	473	213	1·19	0·54	1·37
P. Rose	62	182	40	2·99	0·65	2·21
Zone 3 (Margaret River)—Average	383	685	316	1·79	0·82	2·06
J. H. Oldfield	18	57	59	3·17	3·28	4·26
Zone 4 (Bridgetown)—Average	179	285	146	1·60	0·80	1·87
G. E. White	26	44	52	1·70	2·00	2·39
Zone 5 (Manjimup)—Average ...	222	469	477	2·10	2·10	2·80
G. Jackson	11	43	22	3·91	2·00	4·57
Zone 7 (Denmark)—Average ...	74	89	87	1·20	1·20	1·60
L. S. Anning	15	29	28	1·93	1·87	2·55
Average all Zones, 1933–34 ...	1,633	2,447	1,432	1·49	0·89	1·79
1932–33	1,531	1,854	1,784	1·21	1·16	1·60
1931–32	1,502	1,605	931	1·06	0·71	1·33

* 1 ton hay = 3 tons silage.

A perusal of Table 9 shows that for the present year the average fodder conserved per cow was 1.79 tons reckoned as hay. While this average figure is higher than that for the two previous years, the goal of 2½ tons per cow—which is considered adequate—has not yet been reached, except in individual cases.

It will be noticed that individual competitors in each Zone have attained 2½ tons per cow, the performances of Messrs. P. Rose with a large herd of 62 cows, J. H. Oldfield with 4.26 tons per cow, G. E. White with 2.39 tons per cow, G. Jackson with 4.57 tons per cow and L. S. Anning with 2.55 tons per cow being of particular merit, and indicate that the goal is not an impossible one.

The average conservation in Zone 3 (Margaret River) and Zone 5 (Manjimup) is excellent, and it is informative to know that nearly all competitors in these districts were operating under the Group Settlement Scheme.

TABLE 10.—COMPARISON OF FODDER CONSERVED PER COW IN 1931–32, 1932–33, and 1933–34.

Zone.	Reserve per Cow.						Total Reserve Calculated as Hay (Tons).*		
	Hay (Tons).			Silage (Tons).					
	1933-34.	1932-33.	1931-32.	1933-34.	1932-33.	1931-32.	1933-34.	1932-33.	1931-32.
1 ...	1·23	0·92	0·76	0·51	1·00	0·24	1·40	1·25	0·84
2 ...	1·19	1·02	0·40	0·54	0·50	0·40	1·37	1·19	0·53
3 ...	1·79	1·38	1·12	0·82	1·14	0·90	2·06	1·75	1·42
4 ...	1·60	0·94	1·23	0·80	0·81	0·75	1·87	1·25	1·48
5 ...	2·10	1·58	1·53	2·10	2·29	0·71	2·80	2·37	1·76
7 ...	1·20	2·11	1·62	1·20	2·20	0·71	1·60	2·66	1·86
Av. all Zones	1·49	1·21	1·06	0·89	1·16	0·74	1·79	1·60	1·33

* 1 ton hay = 3 tons silage.

Table 10 shows the improved farming methods being adopted by competitors since the inception of the competition in 1931. During the three years fodder conservation has increased from 1.33 tons per cow to 1.6 tons in 1932-33 or 20 per cent. increase, while a further increase to 1.79 tons was effected in 1933-34, or an increase of 32 per cent. since the inception of the campaign.

It is believed that the example of individual competitors will be emulated by a greater proportion of other farmers in each district year by year, leading to higher production per cow and greater net returns.

Table 10 also shows that each year greater meadow hay reserves per cow were conserved, while silage conserved fluctuated in amount. This fluctuation undoubtedly is due to a seasonal factor. Where the spring is a dry one as in 1933-34, conditions may be unsuitable for the conserving of silage and more hay is conserved. The special benefit of silage is that it lengthens the time during which harvesting can be carried out, and also that in a specially favourable season for pasture growth it enables the farmer to save such surplus feed, which, if left until hay-cutting time, might be too great an area or tonnage to be handled with the labour available.

7.—Mr. P. Rose's Herd of Pedigreed Jersey Cows, "Yeeralla," Burekup. Average production of 64 cows: 281 lbs. butter fat, without allowance for age.

TABLE 11.—ACREAGE OF GREEN FODDER PER COW.

Zone.	Summer Fodders.	Acres sown per cow.
	acres.	
1. Harvey	110·0	0·290
2. Bunbury	16·3	0·040
3. Margaret River	33·0	0·090
4. Bridgetown	1·5	0·001
5. Manjimup	29·0	0·130
7. Denmark	40·5	0·550
Total	230·3	0·141
6. Narrogin	113·0	1·00

GREEN SUMMER FODDER CROPS.

Table 11 sets out the average area sown to fodder crops per cow for each of the seven Zones. It will be noticed that in all Zones except Zone 7 (Denmark) and Zone 6 (Narrogin) the area sown is lamentably small. If the quantity of silage conserved were adequate there might be some justification for small areas of summer crops. As has been shown above, however, the quantity of silage conserved varies with the season, and in 1933-34 the amount conserved was below the amount considered necessary.

For some reason the sowing of summer crops is generally unpopular, as is shown by their consistent neglect—except in the two Zones mentioned above—during the three years of the competition, as is indicated in Table 12. The chief factors for this unpopularity are believed to be those of expense and the uncertainty of results.

Table 12.—ACREAGE OF GREEN FODDER GROWN PER COW.

Zone.	1931–32.	1932–33.	1933–34.
1. Harvey	0·09	0·19	0·29
2. Bunbury	0·08	0·04	0·04
3. Margaret River	0·12	0·14	0·09
4. Bridgetown	0·14	0·02	0·001
5. Manjimup	0·13	0·14	0·130
7. Denmark	0·32	0·38	0·550
Total	0·14	0·127	0·141
6. Narrogin	...	1·56	1·00

It is not uncommon to find such crops as maize sown with expensive fertiliser mixtures, with dressings per acre ranging from 4 to 8 cwt. Maize variety trials and fertiliser trials carried out by the Department of Agriculture over a number of years indicate that such dressings are uneconomical, and that where heavy yields have been so obtained the cost is excessive. The most economical dressing for such summer crops is 3 cwt. of superphosphate and ammonia No. 3 per acre. For those desirous of mixing their own fertilisers, this fertiliser consists of superphosphate, 2½ parts, and sulphate of ammonia, 1 part.

The varying success obtained in the growing of summer crops undoubtedly is due to lack of thorough cultivation of the soil, and, where farmers feel they are unable to give the land the cultivation thought necessary, they would be well advised to desist wasting money on seed and expensive fertilisers—this latter necessity, however, is rather a reflection on capacity for crop husbandry.

One of the special needs for dairy stock during the summer months is an adequate supply of protein nutrients obtainable usually as clover hay or clover silage, the latter for preference.

The cow pea (*Vigna sinensis*) has given very promising results during the last two years in Western Australia and, it is believed, will prove a valuable means of supplementary silage as a source of protein during summer months.

The writer is convinced that further attention to the growing of summer fodders is essential to enable dairy stock to produce to their capacity.

Table 13 shows that in those districts where natural advantages for pasture production are lacking, farmers realise the necessity for the provision of adequate fodder during summer months, and special efforts are made to supply the deficiency; the average conservation in the Great Southern area being 3¼ times that for the wetter districts in the South-West.

Table 13.—FODDER CONSERVED PER COW IN WET DISTRICTS, COMPARED WITH THAT IN DRY AREAS.

Zones.	Hay. Tons.	Silage. Tons.	Total Reserve per Cow calculated as Hay. Tons.
Average—All Zones in Wet Districts ...	1·49	0·89	1·79
Average—Zone 6 (Narrogin)	4·90	2·80	5·83

Zones 1–5 and 7 receive 30ins. to 60ins. rainfall; Zone 6 only receives 17ins. to 25ins.

8. Nine cows from Mr. W. G. Burges's herd, "Tipperary," York
"A tribute to conservation of fodder."

Karrawong Kathleen 5th
11,328 lbs. Milk; 456.8 lbs. Fat.

Karrawarra Lofty 2nd
9,411 lbs. Milk; 390.2 lbs. Fat at 3 yrs.

Vallah Farm Maggie 2nd.
13,233 lbs. Milk; 508.9 lbs. Fat at [illegible]

Karrawarra Plum 3rd.
10,956 lbs. Milk; 422.7 lbs. Fat at 4 yrs.

The Hill Sally.
12,297 lbs. Milk; 497.9 lbs. Fat at 4 yrs.

Widgee Waa Beauty 7th.
6,099 lbs. Milk; 244.7 lbs. Fat at 2 yrs.

Lakeview Polly 2nd
9,219 lbs. Milk; 363.9 Fat at Jr. 2 yrs.

Kurrawong Kitty 8th.
11,535 lbs Milk; 525.9 lbs. Fat.

The Hill Empress 4th.
8,769 lbs. Milk; 365.3 lbs. Fat at 3 yrs.

All above tests are for 273 days

BUTTER FAT PRODUCTION.

The quality of dairy cows in herds owned by competitors has shown a distinct improvement this year, judging by production per cow, the improvement being ascribed almost solely to more adequate fodder being available throughout the whole lactation period.

As an indication of the realisation of the value of breeding, it is pleasing to record that practically every competitor owned pure bred bulls, the number of bulls of the different breeds being shown in Table 14.

Table 14.

The Percentage of Bulls in Use according to Breed.

Breed.	1932–33. per cent.	1933–34. per cent.
Jersey	66·0	57·5
Guernsey	18·0	17·5
Australian Illawarra Shorthorn	11·0	15·0
Ayrshire	5·0	5·0
Friesian	...	5·0
Total	100·0	100·0

1,633 cows were entered for the competition, being an increase of 100 over that of last year, the average production being 208.8 lbs. of butter fat per cow as compared with 201.5 lbs. during 1932-33.

While only six competitors owned herds producing more than 250 lbs. fat per cow in 1932-33, no less than 14 herds exceeded this figure during the present year, the names of these owners being shown in Table 15. It also will be noticed that four herds exceeded 300 lbs. butter fat per cow compared with only one in 1932-33.

Table 15.

Owner.	No. of Cows in Herd.	Production per Cow—lbs. Butter Fat.
A. Trigwell, Donnybrook	17	323·0
S. Bowers, Brunswick	24	322·4
W. Shaw, Harvey	41	319·3
G. Scott, Yarloop	18	319·1
S. F. Russell, Serpentine	32	288·5
A. Millar, Forest Grove	21	287·7
S. Smith, Cowaramup	11	287·4
H. C. Barnsby, Pemberton	19	279·6
P. Rose, Burekup	62	271·8
L. Temple, Harvey	21	258·6
G. F. Combs, Jardee	24	258·3
C. Casselton, Wonnerup	21	254·7
A. Wilkinson, Yoongarilup	18	252·5
Dunkley Bros., Capel	52	250·7
Total cows	381	...
Average	27·2	291·0

Table 16 sets out the average production per cow in each zone, together with that of the highest producing herd in each zone.

The very creditable yields of cows in the leading herds in Zones 1, 2, 3, and 5 will be noticed, and in each case these herds have been bred by their owners by a definite policy of herd improvement by the use of pure bred bulls and careful attention to feeding.

TABLE 16.

Average Production per Cow in each Zone, together with that of the Highest Producing Herd.

Zone.	No. of Cows.	Average Cows in Herd.	Average Butter Fat per Cow. lbs.
1. Harvey	379	35·4	221·5
S. Bowers, Brunswick ...	...	24·0	322·4
2. Bunbury	396	36·0	223·4
A. Trigwell, Donnybrook ...	...	17·0	323·0
3. Margaret River	383	21·3	199·6
A. Miller, Forest Grove ...	...	21·0	287·7
4. Bridgetown	179	25·6	181·1
C. Pearse, Kirup	...	16·0	228·0
5. Manjimup	222	21·8	194·4
H. C. Barnsby, Pemberton ...	...	19·0	279·6
7. Denmark	74	18·5	207·3
P. Berridge, Denmark ...	...	20·0	221·8
Average, all Zones	272·2	26·3	208·8

The yields of the 1,633 cows milked by competitors this season confirm the statement made last year that the average production of dairy cows in the South-West is considerably higher than the State average and approximates 180 lbs. butter fat per cow per annum. It also is significant that in the Bridgetown Zone, where fodder conservation and green "summer" fodder production were low, there was a serious fall in the average production per cow as compared with that for the previous year, namely, a decrease from 205 lbs. in 1932-33 to 181 lbs. fat per cow in 1933-34.

BUTTER FAT PER ACRE.

Table 17 sets out the average production of butter fat per acre, and also the average for the six leading farms in the competition.

TABLE 17.

Average Production of Butter Fat per Acre in each Zone, compared with that of the leading Competitor.

Zone.	Acres devoted to Dairying per Farm.	Average No. of Cows per Herd.	Butter Fat per Acre.		
			1933–34.	1932–33.	1931–32.
1. Harvey –Average	123·8	35·4	61·6	34·8	53·4
S. F. Russell	118·0	32·0	78·2	...	...
2. Bunbury –Average	244·7	36·0	32·8	46·6	50·4
P. Rose	450·0	62·0	37·4	...	...
3. Margaret River – Average ...	91·0	21·3	46·6	43·6	37·9
A. Millar	117·0	21·0	52·0	...	...
4. Bridgetown –Average	134·4	25·6	35·7	40·7	35·1
C. Pearse	100·0	16·0	36·4	...	...
5. Manjimup—Average	85·3	21·8	46·0	38·8	35·5
H. C. Barnsby	77·0	19·0	57·0	...	...
7. Denmark—Average	55·0	18·5	70·0	49·4	45·4
J. J. Daly	90·0	28·0	66·9	...	...
Average, all Zones	126·7	26·3	43·8	42·6	43·0
Average, 6 leading Farms	158·7	29·7	48·6	54·0	40·0

A comparison of the average figures for the three seasons for which information is available indicates how remarkably close the production figures are for each year, and it is believed that these figures give a reliable guide to what may be expected from average land in the South-West under reasonably good management.

In spite of the great variation in the production of the herds, the average production per acre approximates very closely to that of the six leading herds and indicates that *management* plays an important part in net profit from a dairy farm irrespective of the production of the cows.

The results over the three years show that with good management 50 lbs. of butter fat per acre may be expected, though a return of 43 lbs. per acre would be a general average. This is also an indication of the average value of our dairy lands, namely, the capitalisation of the value of 43 lbs. of butter fat per acre. This figure is corroborated by the information in Table 18, which sets out the average area required to support a milking cow or a cow unit which includes, of course, the attendant heifers, horses, and a bull. It is estimated that a 20 milking cow or 20 cow-unit farm will comprise 50 stock, as set out below:—

20-Cow Units.

20	Cows
9	Heifers 2 years old
9	„ yearlings
9	„ calves
1	Bull
2	Horses
50	Total.

Ten per cent. allowed for losses.

TABLE 18.

Acres utilised per Milking Cow.

Zone.	Average No. of Cows in Herd.			Acres devoted to Dairying.			Acres per Cow.		
	1933-34.	1932-33.	1931-32.	1933-34.	1932-33.	1931-32.	1933-34.	1932-33.	1931-32.
1. Harvey	35·7	31·7	31·7	123·8	150·7	138·9	3·6	4·8	4·4
2. Bunbury	36·0	42·2	43·5	244·7	207·5	247·7	6·8	4·6	5·1
3. Margaret River ...	21·3	20·6	19·0	91·0	88·8	81·5	5·8	4·3	4·3
4. Bridgetown ...	25·6	23·3	17·6	134·4	117·4	96·1	5·3	4·4	5·5
5. Manjimup	21·8	23·2	17·1	85·3	118·1	92·4	4·2	5·1	5·4
7. Denmark	18·5	19·0	13·7	55·0	85·1	57·4	3·0	4·5	4·2
Average, all Zones ...	26·3	25·5	23·7	126·7	120·6	119·0	4·7	4·7	4·9

It thus will be seen that, although a cow-unit or milking-cow requires 4.7 acres, this is equivalent to the high carrying capacity of 1.9 acres per head, without other stock, such as pigs, etc.

The figures in Table 18 confirm the statement made in the report of the competition in 1932-33, that an unirrigated farm of 100 acres is fully stocked with a herd of 20 milch cows and that, except in specially favoured areas, a dairy farm of less than 100 acres is not a sound proposition, as it is considered that a herd of 20 cows is necessary to maintain a family in comfort and meet all liabilities.

PIGS.

As pointed out last year, there was a serious fall in the number of pigs, particularly sows, owned by competitors, the reason given being the low prices ruling for pork and bacon, which were unprofitable. Even at the low prices then ruling, however, it has been shown by some competitors that by breeding pigs, as opposed to purchasing, and by growing as much fodder as possible, bacon could be produced at a profit.

Low prices for pig products continued until January, 1934, and the number of sows was found to have still further diminished, so that many farmers are not now in a position to take advantage of the remunerative prices offering. Experience has shown that it is not sound policy to sell or slaughter breeding sows, as they can be maintained very cheaply, and the "price-cycle" for pig products, according to German investigations, is from two to three years. Without good breeding sows the farmer will find it difficult to rapidly increase numbers, and at such periods the purchase of weaners or gilts is unprofitable owing to the high demand.

Table 19 shows the number of sows compared to the number of milch cows in each zone, and the comparison for 1931-32 and 1932-33.

TABLE 19.

Comparison of Number of Sows to Cows.

Zone.	No. of Cows.	No. of Sows.	No. of Sows to Cows.
1. Harvey	379	11	1 : 34·5
2. Bunbury	396	37	1 : 10·7
3. Margaret River	383	24	1 : 15·9
4. Bridgetown	179	16	1 : 11·2
5. Manjimup	222	21	1 : 10·6
7. Denmark	74	6	1 : 12·3
All Zones, 1933-34	1,633	115	1 : 14·2
,, 1932-33	1,531	144	1 : 10·7
,, 1931-32	*950	141	1 : 6·7

* Whole milk suppliers excluded.

The very low figures for the number of sows to cows in the Harvey Zone will be noticed. This is explained by the fact that, in this Zone, eight of the 11 competitors were whole milk suppliers, and did not have skim milk available for feeding pigs.

It is estimated that the profit from pigs averages approximately £2 per cow (though this is exceeded by some competitors) where a butter factory is being supplied and this should be borne in mind when assessing the relative cost of producing whole milk for consumption as such, and butter fat for supply to a butter factory.

Experience has shown that for every four to five cows one breeding sow should be carried. It will thus be seen from Table 19 that this avenue of production and revenue is very seriously neglected on the average dairy farm in this State. The last three years has shown conclusively that for farming to be profitable, all possible avenues of production must be exploited—in short the policy of having all one's eggs in the one basket is economically unsound.

9.—Feeding Silage. H. C. Barnsby, Clovelly Farm, Pemberton.

Table 20 shows the breeds of sows owned by competitors for 1932-33 and 1933-34.

TABLE 20.

Breeds of Pigs owned by Competitors.

No. of Sows.		Per cent.		Breed of Sows.
1933-34.	1932-33.	1933-34	1932-33.	
35	70 ...	30	49 ...	Berkshire
61	55 ...	53	38 ...	Berkshire and Tamworth
1	6 ...	1	4 ...	Middle White
2	4 ...	2	3 ...	Middle White and Berkshire
6	2 ...	5	1 ...	Large White
10	7 ...	9	5 ...	Other Breeds
115	144 ...	100	100	

Table 20 shows that the Berkshire and Tamworth-Berkshire sows are still first favourites, no less than 83 per cent. of sows being of this breed.

Recent experiments have shown that, for West Australian conditions, the Tamworth boar mated to a bacon type Berkshire sow will provide a pig suited to both the local trade, and, if for export, a pig that can be fed to a heavier weight and provide a carcase as suitable for overseas markets as any other breed under local conditions.

From the foregoing it will be inferred that increased attention to pig-raising is strongly advocated in conjunction with butter fat production.

SUMMARY.

1. Permanent pasture production is being developed successfully on irrigated farms. On dry farms a number of promising perennial plants are being tested by farmers, phalaris tuberosa being the most promising to date.

2. Reliance on conserved fodder is essential on all but irrigated farms.

3. The amount of fodder conserved per cow has increased each year since

the Competition was inaugurated, and in 1933-34 was 1.79 tons of hay, or an increase of 34 per cent. since 1931-32. It is considered, however, that the equivalent of 2½ tons of hay per milch cow is necessary for safety.

4. Interest in the cultivation of green summer fodders must be stimulated in some way, the amount grown per cow being only 1/7th acre. (See Table 12.)

10.—Cow Peas and Maize grown by Mr. S. F. Russell, Serpentine.
Photo. taken 10 weeks after planting.

5. The average production of the 1,633 cows in the Competition was 208.8 lb. of butter fat. (See Table 16.) This confirms the statement made last year that the average cows in the South-West produce approximately 180 lb. of butter fat per lactation period.

6. Fourteen (14) herds, totalling 381 cows, produced more than 250 lb. of butter fat per cow compared with six (6) in 1932-33. (See Table 15.)

7. The use of pure bred bulls for grading-up for production is generally recognised, the percentage in use according to breed being as follows:—

Jersey	57
Guernsey	18
A.I. Shorthorn	15
Ayrshire	5
Friesian	5
	100 per cent.

8. The production of butter fat per acre was 43.8 lb., a figure remarkably close to that for the two previous seasons, i.e., 42.6 lb. and 43 lb. (See Table 17.) This figure may be accepted as the expectation for production on average unirrigated land. The six leading competitors, however, produced 48.6 lb. butter fat per acre.

9. The average herd in the Competition contained 26.3 milch cows, the tendency each year being for herds to become larger. (See Table 18.))

10. The average dairy farm comprised 127 acres. (See Table 18.)

11. The area required to carry a milking cow or cow unit has been remarkably constant during the three years, namely, 4.7 acres in 1933-34, 4.7 acres in 1932-33, and 4.9 acres in 1931-32. This figure may be taken as the acreage of average dry land required to maintain a cow unit. (See Table 18.)

12. There is a general lack of attention to avenues of production other than butter fat.

13. Pig-raising has fallen to a dangerously low ebb in that even breeding sows have been disposed of, the number being only one sow to 14.2 cows, or less than half as many as in 1931-32. (See Table 19.)

14. Phosphatic licks are being fed generally, and are essential during the summer months; and, with heavy-producing cows, may be fed all the year round with profit.

SOYA BEAN TRIALS, 1933-34.

H. G. Elliott,
Agricultural Adviser, Dairy Branch.

The soya beans which were obtained through the courtesy of the Ford Motor Company of Australia were the subject of experiments at various centres to determine their possibility as a summer growing legume, as it is necessary for the farmers in Western Australia to obtain a strong growing summer legume to provide a food rich in protein and lime to be used as a supplement with other summer fodders, such as maize, sorghum, elephant grass, etc.

The following table gives the results of the trials for the season 1933-34:—

District.	Rainfall during Growing Period.	Results.
Margaret River ...	500 points ...	Failure; poor germination; no growth.
Muresk	1½ inches ...	Germination good; growth good, but spindly, ground moist, but beans shrivelled up in the hot weather.
Denmark	580 points ...	Failure; plants spindly.
Munja Station ...	26 inches, December to February	Planted 2½ acres. Good season; complete failure Poor germination; stunted plants; no seed production.

Note.—All seeds were inoculated with the Soya bean bacteria just prior to planting.

From the above table it will be seen that failures resulted, and it is believed that this crop is quite unsuitable in Western Australia, with the exception perhaps of some in the irrigated areas.

Good results, however, have been obtained in this State with the growing of cow peas as a summer growing legume to supplement the necessary protein food required.

LOCALLY DESIGNED EQUIPMENT FOR THE COLLECTION OF MILK SAMPLES FOR BACTERIOLOGICAL EXAMINATION.

H. A. PITTMAN, B.A. (W.A.), B.Sc. Agr. (Hons.) (Sydney).
Plant Pathologist.

Following on the establishment in this State by Act of Parliament in 1932 of the Metropolitan Whole Milk Board, it became necessary for the Board to establish some means of obtaining routine bacterial counts of the milk being supplied by dairyman to the consumers of Perth and its environs, at various points in its route from the producer to the consumer. Moreover, inasmuch as it was intended to demand a high quality in the milk, from the point of view, *inter alia*, of maximum permissible bacterial flora (500,000 per cc.), it was essential to evolve some means of ensuring, in the first instance, that a representative sample of milk should be taken, and that, in the second, no increase in the bacterial numbers should take place in the period elapsing between the taking of the samples and their delivery to the laboratory for examination. The Director of Agriculture (Mr. G. L. Sutton) was approached by the Chairman of the Whole Milk Board (Mr. T. H. Wilson) with the proposal that the examination of samples should be carried out in the Dairy Laboratory of the Department of Agriculture, which was then in process of formation under the control of the writer.

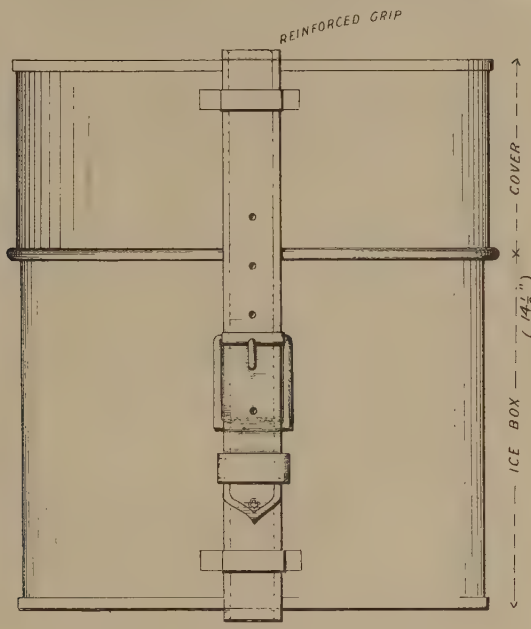
As it was found impossible to purchase suitable equipment ready-made, the apparatus and technique described below was evolved by the writer with the aid of his assistants, Messrs. J. M. Allan, B.Sc. Agr. (Hons.) (W.A.), and H. Kretchmar, B.Sc. (W.A.), A.A.C.I., the valuable help of both of whom is here gratefully acknowledged.

At first samples were taken from, say, 10-gallon cans of milk, by thoroughly agitating the contents with the conventional perforated metal disc stirrers. The samples were then dipped out of the can with a metal dipper and poured into medicine bottles. A sterilised stirrer, sterilised dipper and sterilised bottle were used for each sample taken.

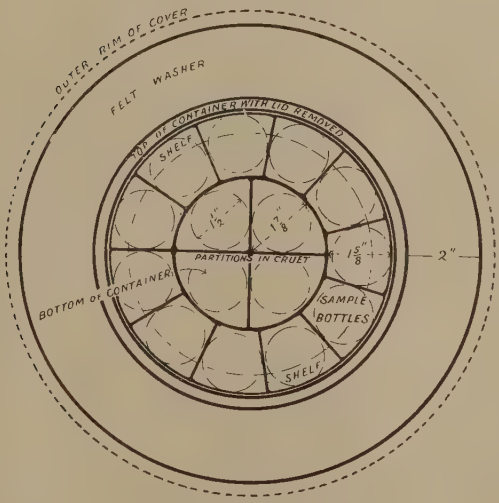
The medicine bottles were soon abandoned for wide-mouthed ground-in glass-stoppered reagent bottles, which were placed in white paper confectionery bags before sterilising in the hot-air oven, and, subsequently, on being unwrapped, each provided with a spring steel clip to prevent any movement between the stopper and its bottle.

Owing to the cumbersome nature of the metal disc stirrers, it was decided to abandon these in favour of Bishop's boiler gauge glasses of two feet six inches in length with a bore of 5/16th inch and a thickness in the wall of approximately 3/32nd inch, making an overall diameter of approximately ½ inch. These are separately rolled up in paper and placed to the number of fifteen in a specially made, welded, stainless steel cylinder before sterilising.

The paper is carefully folded over at each end of the tubes during the rolling up process, so as to obviate the possibility of particles of dust gaining entrance to the tubes prior to use, in spite of the opening of the metal case containing them. The paper covering is made to be a loose fit, the tube being placed



ELEVATION



PLAN OF ICE BOX
(COVER REMOVED)

Fig. 1.—Showing elevation and plan of ice-box used for transporting milk samples for bacteriological examination.

Drawings by courtesy of Chief Draughtsman, Lands Dept.

diagonally on the oblong sheet of paper used for wrapping it, before being loosely rolled up, and the final corner flap of the paper being fastened in position with a dab of paste.

A loose wad of cotton wool is placed on top of the tubes before they are sterilised in their steel cylinder, to provide a means of preventing violent movement of the remaining tubes when some of their number have been removed for taking samples.

THE TECHNIQUE OF SAMPLING.

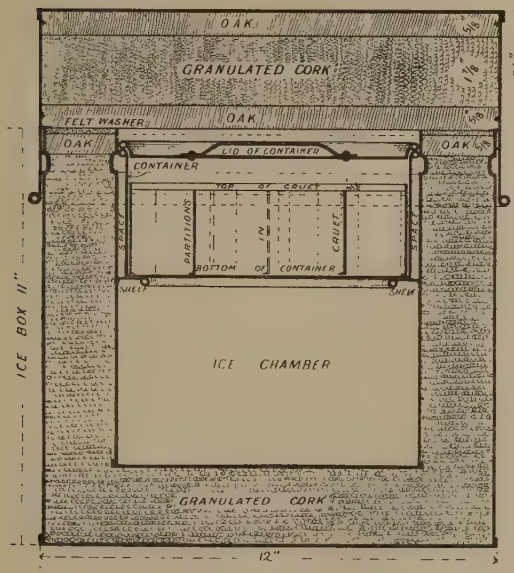
When sampling, the spring clip is first removed from the sample bottle and placed on one side. The top of the paper sheath surrounding a glass sampling tube is then broken open and the tube carefully pulled out, care being taken not to touch any part of the tube, with the exception of the upper end. The milk is then thoroughly stirred by vigorous clockwise and counter-clockwise movements of the rod in the milk. A small wad of cotton wool which is inserted into each tube before sterilising prevents any contamination entering the milk in the tube from the operator's thumb, etc.

When the milk has been thoroughly stirred, the tube is withdrawn from the can, allowed to drain for a moment or two, then *slowly* lowered vertically through the milk until it reaches the base of the can. The mouth of the tube is then closed with the thumb and a column of milk is drawn out and carefully allowed to run into the sterilised numbered bottle which has just previously had its stopper removed with the other hand and is waiting to receive it. After the milk has drained out of the tube, the used tube is placed back into its paper sheath (this is not important), and then into a second stainless steel cylinder which is carried by the Inspector for the purpose of receiving the used tubes. These used tubes are protected from breakage by loosely plugging the space between the tubes with cotton wool or a roll of paper. A wad of cotton wool reposes in the bottom of each metal container to prevent breakage of the tubes by sudden contact with the bottom of the metal cylinder.

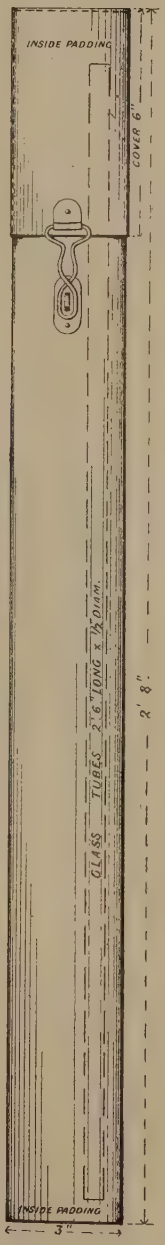
The spring clip having been placed back on its bottle, which bears a numbered metal tag wired to the neck, the bottle is placed in one of the compartments of the "cruet" section of the ice box. This ice-box (see figs. 1, 2, 3 and 5) holds about 7 lbs. of finely crushed ice which is placed in the ice chamber by the Inspector some time before the first samples are taken, so that the temperature of the interior of the ice-box will have been reduced to about 0°C. when the samples are taken. It has been found that the 7 lbs. of ice will last for about 48 hours in the summer months when the shade temperature may be in the vicinity of 100°F.

As commonly used each ice-box holds 15 one-ounce, wide-mouthed, ground-in glass-stoppered sample bottles, but, by the use of a differently designed "cruet" section, one dozen two-ounce bottles may be carried in each box. Each sampling tube delivers about one ounce of milk from a full 10-gallon can. The metal parts of the ice-box are made entirely of "nickel silver," and the conduction of heat from the bottles to the ice chamber through the metal work is very rapid. The detailed structure of the ice-box and of the metal cylinders for holding the sampling tubes is shown in figs. 1, 2, 3, and 5.

In connection with the sterilising of the equipment used, a special hot-air sterilising oven fitted with automatic thermostat was also designed by the writer in co-operation with Messrs. J. M. Allan, H. Kretchmar and Metters Ltd., Perth.

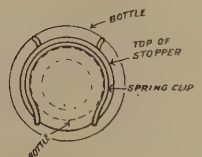


SECTION



TUBE CASE

SAMPLE BOTTLE
ENLARGED DRAWING



ENLARGED DRAWING
SHEWING SPRING CLIP

PLAN

Fig. 2.—Showing section of ice-box, elevation and plan of stainless steel cylinder for carrying glass sampling tubes, and sample bottle with spring clip to prevent movement of ground-in glass stopper.

Drawings by courtesy of Chief Draughtsman, Lands Dept.

It is sufficiently long to hold the metal cylinders, with their contained paper-wrapped boiler tubes, in a horizontal position, with an inch or two to spare at either end. Twelve metal cylinders may comfortably be accommodated at the one time, together with approximately 180 sample bottles (twelve sets), and a large number of 1 c.c. pipettes for use in making the milk smears in the laboratory. The temperature used for sterilising the glass-ware, etc., is 150 deg. C. (302 deg. F.) for 1½ hours, although the oven can be set to run at considerably higher temperatures if required. Automatic control of the temperature is obtained with a "Sperson" thermostat. The oven with the doors closed and open respectively, is pictured in Figs. 4 and 5.

As a result of the use of the apparatus referred to in this article, it has been found quite easy to detect with certainty the dairymen using uncleanly production methods, and subsequent inspections of these dairymen's production techniques, by an officer of the Dairy Branch of the Department of Agriculture, acting under instructions from the Superintendent of Dairying (Mr. G. K. Baron-Hay), have usually resulted in a speedy solution of the cause of the excessively high bacterial counts and consequently marked improvement in keeping quality.

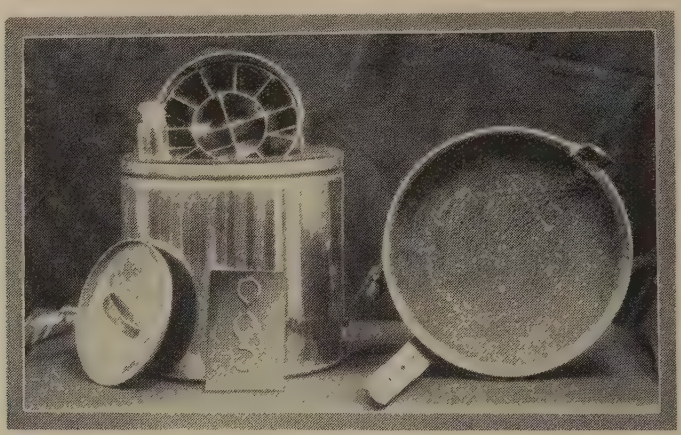


Fig. 3.—Ice-box for transporting milk samples for bacteriological examination, showing lid of ice-box from its under side, the "cruet" in its "cruet" container tilted on its side so as to show the compartments into which the sample bottles are placed, the lid of "cruet" container leaning against left side of ice-box (on which it is throwing a heavy black shadow), one sample bottle standing on the felt washer which makes a compressible seal between ice-box and its lid, and three spring steel wire clips for sample bottles sewn to black card for photographic purposes.

Photo. by Govt. Printer.

BRIEF SPECIFICATIONS OF ICE-BOX.

Overall height, excluding leather straps, 14⅛ inches; diameter, 12 inches; height of ice-box without lid, 11 inches; width of felt washer used between ice-box and its lid, 2 inches; thickness, ¼ inch; thickness of granulated cork layer in wall of ice-box and below ice chamber, 2 inches; thickness of silky oak below felt washer, above felt washer and below metal top of ice-box lid, ⅜ inch; thickness of granulated cork in ice-box lid, 1⅝ inches; total overall depth of lid of ice-box, with overlap, 5⅛ inches; metal exterior of ice-box lid overlaps ice-box for 2 inches.

Diameter of ice chamber, 7⅞ inches; height of ice chamber, 5 inches; width of shelf supporting "cruet," ¾ inch; depth of "cruet," 2½ inches; internal dia-

meter of "cruet," 7⅜ inches; overall diameter of "cruet," 7 7/16th inches; internal diameter of "cruet" container, 7½ inches; overall diameter, 7¾ inches; height of "cruet" container, 3⅜ inches; space between base of "cruet" container and lower side of its lid, 3⅛ inches. This allows approximately ⅜ inch between top of sample bottle and lower side of lid of "cruet" container. Height of "cruet" container lid with handle, ¾ inch; height of sample bottle 2¾ inches; diameter, 1½ inches. The four central compartments of the "cruet" are 1⅞ inches inside radial

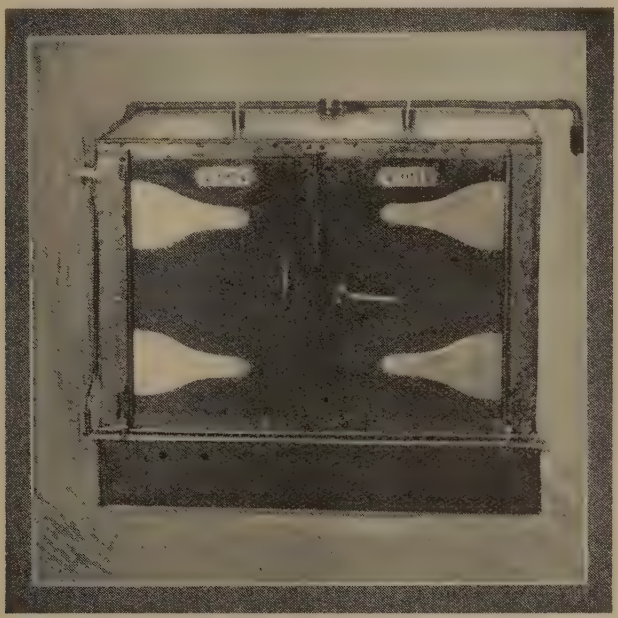


Fig. 4.—Hot-air-sterilising oven for sterilising glass sampling tubes in their stainless steel cylinders, sample bottles, milk pipettes, etc., Note the two thermometers inserted through openings in the top of oven, the protruding portion of thermostat near top left-hand side, and flue for controlling air circulation in middle back of top of oven. The oven stands under an exhaust hood which removes the heated air from the room.

Photo. by Govt. Photographer.

measurement. The eleven peripheral compartments are 1⅝ inches in inside radial measurement. Thickness of turned-over metal approximately 1/32nd inch, except at centre, where four partitions meet, where it is ⅛ inch. The "cruet" has no top or bottom of its own, but rests on the bottom of the "cruet" container, on which it is free to move in a circular manner. It is a fairly tight fit in the "cruet" container, but can easily be removed from it. The "cruet" container similarly fits into the central cavity of the icebox rather snugly, but this also can be readily removed so that ice can be placed into the ice chamber, or the water poured out when the ice has melted, etc.

The dimensions of the "cruet" and "cruet" container relative to those of the sample bottles being used are the most important. The rest of the ice-box can be considered as being built up around these two central units. All metal used was

24-gauge nickel silver throughout. The ice-box is carried by means of a stout leather strap with reinforced handle, and a large buckle on each side of the box to allow lid to be removed. The ice-box weighs approximately 22 lbs. without ice or sample bottles, 31½ lbs., approximately, with ice and empty sample bottles, and 32½ lbs., approximately, with ice and full sample bottles.

BRIEF SPECIFICATIONS OF STAINLESS STEEL CYLINDERS.

Overall length, 2 feet 8 inches; overall diameter, 3 1/16th inches; 20-gauge "Staybrite" stainless steel; lid, 6 inches long; overall diameter, 3 3/16th inches; 20-gauge. Boiler tubes for sampling, Bishop's "Adamant," 2 feet 6 inches long by ½ inch overall diameter by 5 16ths bore; wall, 3 32nds inch thick. The capacity of the Boiler tubes is 15.5c.cs. per foot of length. Tubes with a bore of ¼ inch were ordered but could not be obtained.

The steel cylinders are now being fitted with steel handles just above the point of balance to facilitate carrying them. The cylinders weigh 4½ lbs. each when empty and 9 lbs. when full of paper-wrapped Boiler tubes.

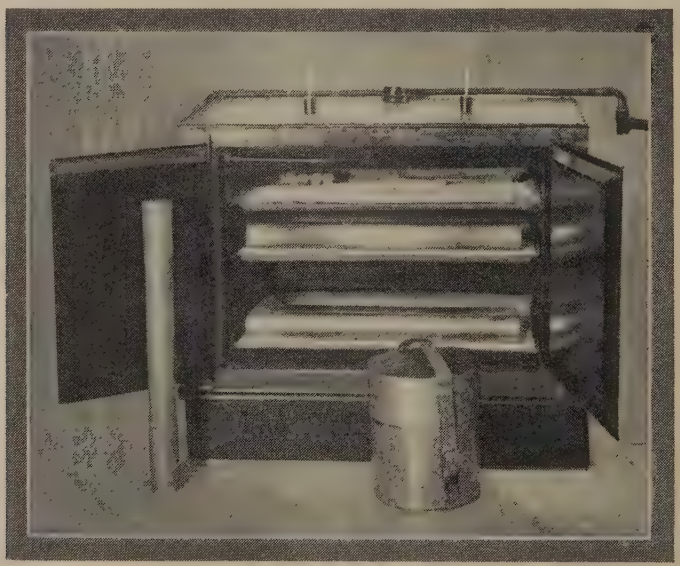


Fig. 5.—Hot-air sterilising oven with doors open, showing the three shelves, the bottom two of which bear several stainless steel cylinders, while the top one carries several sample bottles and a large number of paper-wrapped pipettes. Paper has been placed on the shelves to increase the contrast when taking the photograph. Note stainless steel cylinder standing in front of door on the left and ice-box on laboratory floor in front of oven. The whitish patches on the door on the right are reflections from the cylinders in the oven.

Photo. by Govt. Photographer.

BRIEF SPECIFICATIONS OF HOT AIR STERILIZING OVEN.

Internal length, 3 feet; internal width, 2 feet 1 inch; internal height, 2 feet. Three perforated shelves 6 inches apart, with bottom shelf 6 inches above floor of

oven. Back and doors 1¼ inches thick, lagged right through. Inner wall of oven hollow with 1-inch cavity in sides and roof, and 2-inch cavity in floor; lagged below the floor cavity 1¼ inches.

Outside the hollow inner wall is a second cavity on sides and roof only, 1¾ inches wide. This is surrounded by a wall lagged with slag wool 1¼ inches thick. In the outer cavity on each side of the oven is a horizontal tube burner extending the full length of the side of the oven. This is placed level with the floor of the oven.

The waste gases from the burners pass up through the outer cavity of the sides and roof to the flue at the middle back of the oven. This outer cavity in the roof is baffled to ensure even distribution of the heated gases from back to front of oven.

The air in the inner cavity, which has become heated by contact with its hot outer wall, passes to the top of the oven, circulates through a series of perforations along the median zone of the roof into the interior of the oven, and thence through perforations in the median zone of the floor, finally passing back through a row of perforations in the outer wall of the inner cavity to the burners. Air can only enter the inner cavity through perforations situated on each side of the oven in communication with the air below the oven floor.

The overall length of the oven without thermostat is 3 feet 9½ inches, with thermostat 4 feet; overall width is 2 feet 6 inches, and the overall height without stand is 2 feet 7¼ inches. The stand is 9 inches high.

The top of the oven overhangs the sides, back and doors to a slight extent.

MAIZE VARIETY TRIAL.

H. G. ELLIOTT,

Agricultural Adviser, Dairy Branch.

Resumé of the results to date of the Maize Variety Trial conducted throughout the South-West during the 1934 season.

In recent years a number of new varieties of maize have been evolved in New South Wales, with a view to producing early growing varieties which will be heavy yielders of green fodder or grain respectively.

It was suggested, therefore, that a variety trial embracing some of the newer varieties compared with the standard variety of "Hickory King" should be instituted.

The object of the trial was as follows:—

1. To determine which variety, if any, gives higher yields of green material per acre than "Hickory King."
2. To determine whether any of these varieties are suitable for the production of grain in Western Australia.

The following nine varieties were considered suitable for trial:—

1. Hickory King—Standard for green fodder in this State.
2. Small Leaming—For green fodder.
3. Fitzroy—For green fodder.
4. Silvermine—For green fodder.
5. Early White Dawn—For grain and early green feed.
6. Funk's Early Yellow Dent—For grain and green fodder.
7. Early Morn—For grain and green fodder.
8. 90-Day (Flint)—For grain and early green fodder.
9. Wellingrove—Green fodder.

Fertiliser.—A number of fertiliser experiments with the growing of maize have been carried out for some years in this State, with the result that the general recommendation for the growing of maize is a mixture of superphosphate, 2½ parts, and sulphate of ammonia, 1 part, which can be obtained in commercial mixtures. This mixture was sown at the rate of 3 cwt. per acre. The cost of the fertiliser was borne equally by Cuming, Smith & Mt. Lyell Farmers' Fertilisers, Ltd., and the Department of Agriculture.

There were 16 farmers selected to conduct trials, and each farmer had five varieties with "Hickory King" as "control."

Each variety was sown in triplicate in rows 30 inches apart, the rate of seeding in every case being 25 lb. per acre.

The following Table 1 gives the results of the first series:—

TABLE 1.

		Hickory King.	Silver-mine.	Wellin-grove.	Fitzroy.	Small Leaming.
S. F. Russell, Serpentine	Tons per acre ...	7·570	7·810	6·835	9·275	7·320
	Percentage Yield	100	103	90	123	97
W. Wells, Group 53, Busselton	Tons per acre ...	6·140	7·230	6·160	8·208	8·122
	Percentage Yield	100	118	101	134	132
G. Doyle, Margaret River	Tons per acre ...	20·32	17·41	10·27	20·07	16·25
	Percentage Yield	100	85	95	99	80
E. Merritt, Group 109, Northcliffe	Tons per acre ...	10·25	11·80	10·14	11·67	11·83
	Percentage Yield	100	114	98	114	115
J. A. Baron-Hay, Wagerup	Tons per acre ...	17·875	16·600	17·875	16·860	24·514
	Percentage Yield	100	98	100	94	137

The average production of green material for this series is given in Table 2.

TABLE 2.

Variety.	Tons per Acre.	Percent. Yield.
Hickory King	12·431	100
Silvermine	12·170	98
Wellingrove	10·056	81
Fitzroy	12·217	99
Small Leaming	13·605	109

S. F. Russell, Serpentine.

Planted on 9th December on heavy red clay loam and grown under irrigation. Cow peas were grown in conjunction with the maize. The height of the crop ranged from six feet with the "Small Leaming" to 10 feet with the "Fitzroy" variety. Strong easterly winds caused considerable damage to the crop.

W. Wells, Group 53, Busselton.

The varieties were grown on a grey clay loam which originally carried marri and jarrah. Planting was carried out early in December.

G. Doyle, Margaret River.

Planted on a red loam running into a fine gravel, and grown under irrigation. This crop was excellent, with the exception of "Small Leaming," which gave the lowest yield.

E. Merritt, Group 109, Northcliffe.

The average height of the crop was eight feet. "Hickory King" and "Wellingrove" were the earliest to mature, while the "Fitzroy" was the latest maturing variety.

J. A. B. Hay, Wagerup.

Grown under irrigation on a sandy soil, "Small Leaming" was undoubtedly the best yielder of green fodder, and appears to mature about mid-way between "Hickory King" early and "Fitzroy" late.

Table 3 gives the results of the second series:—

TABLE 3.

Green Material.

		Hickory King.	Early White Dawn.	Early Morn.	Funk's Early Yellow Dent.	90 Day (Flint).
P. Gibbs, Vasse ...	Tons per acre ...	13·980	13·152	11·116	11·116	10·125
	Percentage Yield	100	94	80	80	73
A. Millar, Forest Grove	Tons per acre ...	5·899	4·828	4·714	5·064	3·535
	Percentage Yield	100	82	80	86	60
T. Briggs, Byford ...	Tons per acre ...	12·257	15·220	16·343	18·900	17·875
	Percentage Yield	100	125	133	154	146
J. A. B. Hay, Wagerup	Tons per acre ...	17·875	13·530	12·500	10·800	12·000
	Percentage Yield	100	76	69	59	66

The average production of green material and the percentage yield for this series are given in table 4.

TABLE 4.

Variety.	Green Material. Tons per acre.	Percentage Yield.
Hickory King	12·502	100
Early White Drawn	11·701	94
Early Morn	11·193	90
Funk's Early Yellow Dent	11·470	92
90 Day (Flint)	10·884	87

P. Gibbs, Vasse.

Plots were seeded on 15th December, 1933, on chocolate loam which originally carried red gum, jarrah and banksia, and the weights were taken at the cobbing stage on 2nd March.

"Funk's Early Yellow Dent" was slightly later than the others, and "Hickory King" was the most outstanding variety.

A. Millar, Forest Grove.

Planted on 9th and 19th December on a red loam originally timbered with karri and red gum. The light weights obtained per acre were due chiefly to late seeding.

T. Briggs, Byford.

Planted on sandy soil overlying a gravelly clay subsoil. At the latter end of the growing period, irrigation was supplemented. Weights were taken when the main bulk of the plants were fully cobbed.

The average for all trials completed to date is shown in table 5.

TABLE 5.

Variety.	Number of Trials.	Green Material.	
		Tons per acre.	Per cent. Yield.
Hickory King	9	12·462	100
Small Leaming	5	13·605	109
Fitzroy	5	12·217	99
Silvermine	5	12·170	98
Early White Dawn	4	11·701	94
Funk's Early Yellow Dent	4	11·470	92
Early Morn	4	11·193	90
90 Day (Flint)	4	10·884	87
Wellingrove	5	10·056	81

The experiment indicates that at present no departure from the standard variety, "Hickory King," can be recommended.

The results of weights of green material for those experiments not yet completed, and the yields of seed obtained from all experiments, will be published in the next issue of the Journal.

THE DEVELOPMENT OF THE EARLY TOMATO INDUSTRY AT GERALDTON.

B. R. CARSON,

Geraldton District Tomato Growers' Association.

Invariably when the average person thinks of tomatoes, such thoughts are associated with hot summer days and the refreshing salads and other cooling dishes with which this delicious fruit is associated. Hence, up to a few years ago the city of Melbourne was practically bare of tomatoes during the winter months and this was chiefly due to the fact that none were available, the geographical situation and climatic conditions of Victoria being entirely against the growing of tomatoes during the cold season. Through this reason alone, there has developed in the Geraldton district of Western Australia, a primary industry that is not only unique but also a powerful factor in the lives of many members of the community.

It was found that the very mild winter climate of Geraldton, combined with the class of soil available close to the coast, made an ideal combination for the growing of tomatoes that would ripen in the winter months.

Experimental shipments to the Melbourne market on a very small scale were tried and found moderately successful. Since then the quantity exported has increased by leaps and bounds and the Sydney market has been tried and also found to be successful during a certain period of the winter. From such a small beginning, the export of tomatoes to the Eastern States from Geraldton reached the huge total of 107,000 half cases during the winter of 1933, or about 1,150 tons dead weight of tomatoes—certainly an astonishing figure. Besides this, the Perth market is also supplied with a sufficient quantity of the fruit to meet the demand as well as with peas and beans, which also grow with equal abundance in this most remarkable climate.

It can be readily recognised therefore, that this industry is a wonderful asset in the Geraldton district, providing the means of a livelihood to hundreds of people and being responsible for a big yearly income to the district.

Nevertheless, it must not be imagined for a moment that the tomato-growers of Geraldton have discovered the "El Dorado" of gardening—quite the reverse. To be a successful grower requires the possession of most human virtues, the ability to work, and work hard, a superabundance of tenacity of purpose and a knowledge of agricultural science equal almost to that of a scientist.

The growers have many difficulties to contend with, chief of which are the many diseases that must be constantly fought, sometimes successfully, at others much the reverse.

As the growth of the tomato depends entirely on the natural rainfall, seed beds planted in the late summer months have to be watered by hand, a costly and difficult procedure, especially when the water has to be carted. Because of the winds for which Geraldton is notorious, each paddock has to be bush fenced to protect the plants from the wind as much as possible. Many varieties are grown on stakes which mean more expense and more work. During the whole growing period, all plants must be continuously sprayed and dusted to combat various diseases and this is perhaps the most monotonous and costly procedure of the many that the patient grower must undertake.

Now comes, perhaps, the most amazing part of this particular industry, the transportation of the product from Geraldton to Melbourne and Sydney by rail and steamer.

Commonsense indicates that it would be impossible to transport a ripe tomato from Geraldton nearly 3,000 miles over a period of nine or 10 days, subject it to all varieties of temperature, hot and cold, humid and dry, to knock it about with seven or eight different handlings, and expect it to arrive otherwise than a pulpy mess. The fruit is therefore picked in Geraldton at that particular stage of greenness which the grower considers will ensure it being just ripe when it reaches its destination, after allowing for all the aforementioned contingencies. When one considers that the fruit leaves a comparatively warm climate, is transferred from railway trucks at Fremantle to the 'tween decks of an interstate ship after a railway journey of 300 odd miles, is transported by sea to Melbourne and Sydney and arrives at its destination in a temperature of perhaps 40 or 50 degrees, the successful judgment of the grower is nothing short of miraculous.

But the grower being only human, has not the gift of second sight, so he cannot foresee the climatic changes to which his fruit will be subjected. There are many, varied and inconsistent. No two ships carry the fruit at the same temperature, no two train journeys from Geraldton are the same, thus it occurs that sometimes the fruit arrives in Melbourne quite green, sometimes it is over-ripe and

occasionally it is just semi-ripe. It must be remembered that this fruit is an extremely delicate and perishable product and it cannot be carried in freezing chambers, a peculiarity of tomatoes; therefore, it is palpably plain that the picking, packing and transportation is a feat that requires great judgment and experience. Being packed in jarrah half-bushel cases gives the fruit strong protection from the many rough handlings it receives, the jarrah being cheaper and more efficient than white wood.

On arrival in Melbourne the fruit is cleared, distributed to selling agents at the wholesale fruit markets and sold. The whole time it is under the control of a direct market representative of the Growers' Association from Geraldton, who clears it, fixes the price at which it is to be sold, reports on the condition of the various lines to different growers and is directly responsible to the growers for the marketing of the product.

The fruit is rigidly inspected by the Agricultural Department of Victoria and must conform to the various regulations of that State regarding quality, packing and grading. At certain times much of the fruit has to be completely repacked and high waste is caused through various diseases, grubs, over-ripeness, etc., which always develop after leaving Geraldton—as the grower packs only sound fruit.

During the period this product is on the Melbourne market, from the months of August to early November, it does not now have the monopoly of the market. In active competition are the South Australian glass-house tomatoes. These are grown in the suburbs of Adelaide and are an excellent looking fruit produced at a high expense in glass-houses and have the advantage of being only two days from the selling market. Naturally, because of their good appearance, they command a better price than the West Australian tomato. The Geraldton product, however, has the distinct advantage of being naturally grown—not forced, with the result that its flavour is far superior.

Despite the practice of the buying public in buying any fruit on its appearance, the Geraldton tomato is already causing grave concern to the Adelaide growers and as the standard of quality improves, which it must do eventually, there may be a chance of the South Australian growers holding off the Melbourne market until the Geraldton crop is finished. Notwithstanding the very high cost of marketing the Geraldton product, the South Australian is even higher, hence the worry of the Adelaide growers.

By intensive organising and producing a higher quality product, there may be a chance of the Geraldton tomato becoming even a greater factor in the fruit markets of Melbourne and Sydney, but until that ideal state of perfection in quality is reached, the industry can only slowly develop on its own merits.

Such is the Geraldton tomato industry unadvertised, to many practically unknown, yet it is perhaps the only West Australian industry that is helping continuously to offset the adverse trade balance with the Eastern States.

The industry is worth about £45,000 net return to the growers and quite a large sum of money in freights to the railways and interstate shipping companies, employs many men and supports hundreds of people, contributes large orders to the various case making mills in the South-West, superphosphates, manures, sprays, dusts, machinery and all the incidentals appertaining to tomato gardening and, lastly, produces one of the best flavoured tomatoes grown in Australia.

The most remarkable feature of the whole industry is that about 40 per cent. of the tomatoes grown are thrown away, unfit for marketing, as only the very best quality can be sent away.

It is to be hoped that any assistance the various Government Departments can give to the growers to avoid this huge economic waste and improve the quality of the product generally, will be readily forthcoming as these hardy growers in the north certainly deserve all they receive.

HONEY—A FOOD AND A MEDICINE.

H. WILLOUGHBY LANCE, Apiculturist, Department of Agriculture.

The human body requires a great variety of substances for its growth, maintenance and development. The food required by growing children is much the same for all, but the food necessary for the maintenance and development of the adult may vary, according to the class of work engaged upon.

Certain classes of food are, however, required by humans of all ages, no matter what their occupation may be. One of the most important of these is the hydrocarbon group, and one of the commonest of this group is sugar. Sugar is commonly produced from the ground by growing vegetable matter. The commonest form of sugar known is that produced from the sugar cane, and is to be found in practically every household in Australia. In European countries a large amount of household sugar is manufactured from the sugar beet. Both these sugars, however, are manufactured articles; that is to say, they are not in their natural state; they have been extracted from the cane or beet and gone through certain processes known as refining during which everything that is not plain sugar is removed.

The sugar contained in fruit and honey is just as Nature provides it and is in conjunction with certain acids and mineral salts which the body requires.

Chemically, there are three principal sugars contained in honey:—cane sugar (sucrose), grape sugar (dextrose), and fruit sugar (levulose), the last two together being called "invert sugar"—that in plain words mean that it has been inverted or changed. Cane sugar (sucrose) requires to be changed before it can be used by the human body; invert sugar has been changed and is ready for assimilation by the blood stream almost immediately it has been passed into the stomach. The sugar on our breakfast and tea tables is pure sucrose and must be acted upon by the secretions of the stomach and inverted before it can be passed into the blood stream.

Honey contains less than 2 per cent. of sucrose, and often practically none, and from 75 per cent. to 85 per cent. of invert sugar. It will thus be realised that the sugar in honey requires practically no effort to digest and the human body obtains the full benefit of the carbohydrate food. Carbohydrate foods are classed as fuel foods which supply the body with the energy needed for the various tasks it performs, rather than those whose function it is to build and repair the body. In addition to sugar, honey contains volatile oils which give it its aroma and flavour, and indicate to a large extent the plant from which it has been obtained; also a small amount of mineral matter, including magnesia, iron, calcium, phosphorous, etc. In this respect it differs from white household sugar, from which the mineral substances originally present in the plant juices have been removed by the refining process. Although the amount of these mineral substances in honey is not high,

their presence must not be disregarded, as in many of the present day foods they are entirely lacking.

As mentioned previously, honey contains both dextrose and levulose sugars, and it depends on the proportion of these and their relation to the percentage of water as to whether the honey granulates or crystallises solid, or only becomes thick, or whether a portion is solid and a portion liquid. The dextrose sugar granulates but the levulose does not. When the honey has a solid appearance all through, the levulose or fruit sugar fills in the spaces between the granules and is usually small in proportion; when part is granulated and part liquid, the levulose is greater in proportion.

Any honey that has granulated may be made liquid again by immersing the jar in water and raising it to a temperature not higher than 140deg. F., that is to say, not hotter than one's hand can stand. The jar should not come in contact with the bottom of the vessel containing the hot water, but should stand on a piece of wood placed therein.

The value of honey is the same whether liquid or granulated—it is only a physical change that has taken place.

Another important value of honey is its inability to carry germs of any disease that attack the human frame, being self sterilising. The reason for this is that it is hygroscopic, that is to say, it attracts moisture to itself. All life contains water, even the smallest disease germ contains moisture, and if this is removed, it dies. Any germs, therefore, that may find their way into honey are destroyed by having their moisture taken from them by the honey. This is an important fact, which it is not believed applies to any other food.

Medical testimony in favour of honey is increasing daily. Only two, however, will be quoted:—

Dr. Henry Lindlaker, in his Vegetarian Cookery Book, writes:—"Always the natural sugars should be used. Honey is the very best of all and should be given preference when available. Maple and pure cane syrup come next in order, then the brown unrefined cane or beet sugar. The highly refined inorganic sugars, powdered, and loaf sugars should not be used."

He is quite definite as to honey taking first place above golden syrup and brown sugar, and advises people not to use white sugar.

Sir Arbuthnot Lane, a physician on the staff of the Lady Margaret Hospital, London, in a booklet entitled "Honey for Health," says that "Honey is a food full of energy and therefore stands high as a producer of stamina and strength. Those who add honey to their daily diet may be assured that they are adding to their capacity to work with hands and brain. If every traveller would ask at his hotel for honey with his porridge or cereal foods, he would be far more fit to tackle the day's work. Honey has practically no waste matter in it. Extracted honey is one of the few foods that is all food, and is easily digested." He further goes on to say, "Where people are below par or depressed, where there is chronic constipation with absorbent poisoning, and in children's ailments, honey is a great panacea."

Trade and national conditions are still stated to be depressed. What a pity we cannot take the good doctor's advice and feed them on honey. However, the next best thing is for each individual to make honey an article of daily diet, which will add vim to his constitution and assist him to look on the bright side of things and not meet trouble halfway. All households should have both granulated and liquid honey on the meal tables; granulated honey as a spread on bread, biscuits,

etc., and liquid for use with porridge, cereal foods, fruit salads, etc., and in the place of sugar in tea, coffee, cocoa, lemonade, and other drinks. To the few persons who maintain that they cannot eat honey, I would say "Take it in your drinks, and I am sure you will benefit thereby."

Another important use of honey is for cookery purposes in the place of sugar. In early days before the introduction of sugar, honey was practically the only method of sweetening known. In many countries to-day it is coming into its own for cooking purposes and is no longer a luxury. The twentieth century homemaker is dressing salads with honey, is flavouring tea fancies and cakes with honey, is baking ham for dinner with honey, and surprising evening guests with tasty honey nut sandwiches and delicious fancy cakes and biscuits made with honey.

In using honey for cooking it must be remembered that good honey contains about 17 per cent. water; therefore in mixing, less water will be required than with sugar; also that a cup of honey is heavier than one of sugar; that a cup of honey weighs 12 ounces and sugar 7 ounces, the weight of the sugar in the cup of honey being 9½ ounces as against 7 ounces in the cup of sugar.

One of the advantages of using honey in cakes is that they will keep moist for a very long period, and in fact are improved by keeping. It may, however, be very difficult to keep honey cakes, especially where there are children, unless they are under lock and key.

There are many kinds of honey in the shops, and a large number of people judge honey by its colour and perhaps mild flavour. This is a great mistake. Honey should not be judged by colour, but by its food value and flavour. The darker honeys have been proved by analysis to have a better food value generally than the lighter ones. Some of them certainly do not have an attractive flavour, but this can also be said of many of the light ones.

It is, however, largely a matter of use, and consumers are advised to accustom themselves to a medium coloured honey of heavy body. Thin honeys contain an excessive amount of water and are liable to ferment.

Summarised, the value of honey may be placed under six headings:—

1. It is the only natural sweetening substance on the market.

2. It has already been changed or digested by the bees, and is almost immediately passed into the blood stream.

3. It is an energy producing food.

4. It contains mineral and other substances, so necessary for the maintenance of health.

5. It cannot carry disease harmful to human beings.

6. Last, but not least, it is pleasant and attractive to the taste.

The value of the regular use of honey as an article of daily diet cannot be over-estimated. In addition to this it has an important value as a medicine. Doctors in Europe and America now recognise this, and use it in their regular practice. It is not used in prescriptions on account of its power to counteract disagreeable flavours, but on account of its healing and soothing qualities. It is a well known cure for colds on the chest, influenza, sore throat, etc., taken with hot milk or lemon.

As a cure for constipation a dessertspoonful in a glass of hot water night and morning will nearly always cure this trouble.

Being antiseptic and drawing, it is a wonderful remedy for boils, carbuncles, septic poisoning, and is used by many doctors in prescriptions for pastes for these diseases, making lancing or cutting unnecessary except in late treatment or very severe cases. A simple paste for this purpose may be made with a dense honey; preferably dark coloured, as this contains more iron and tannic acid: mixed with flour, applied to the place on a piece of lint and covered with oiled silk or jaconet and renewed two or three times a day. This has a powerful drawing action and will cause the rupture or opening of the skin, allowing the pus to drain out, and there will be no scar left. The writer has personal proof of the efficiency of this treatment in the case of severe septic poisoning. Boils are usually relieved in a few days, but carbuncles, being more persistent, may take weeks of treatment.

Similar treatment to the above is excellent for burns and scalds, and is also a cure for piles.

The following is an extract in regard to the use of honey as a cure for toothache:—"It is my honest opinion that no living person knows the therapeutic value of honey. How many persons know that it is a wonder remedy for toothache, even where one is suffering from an abscess! Just take a big swallow in the mouth and hold around the affected tooth for a while. It usually does the trick in a few minutes. I have never known it fail. I have sold numbers of people honey for this specific purpose and everyone of them, without exception, has told me that it worked like a charm." (Emmett Baxter, Philadelphia.)

The writer is not able to prove this statement, being past the stage of toothache, but would like to hear from any person who gives the above a trial.

Honey is also an excellent cure for bee stings, especially if applied as a paste and covered up. For frost bites on ears, fingers, etc., apply honey or honey flour paste and wrap up.

For inflamed and sore eyes, a drop or two of liquid honey put in the eyes several times has been known to bring wonderful results, when all else has failed.

Equal parts of honey and cream mixed together is an excellent cosmetic, softening and beautifying the skin, and is said to be a good remedy for freckles.

A splendid candy for colds, coughs, etc., can be made as follows:—Boil a strong solution of horehound leaves in soft water, strain through muslin, add as much honey as desired, boil until all the water evaporates, pour in shallow vessel, and allow to set.

The apiculturist will be pleased to hear at any time from readers desiring information about honey or bees, or requiring recipes for specific purposes, and also to hear of their experience with the various uses of honey.

RABBIT DESTRUCTION—WINTER OPERATIONS.

A. ARNOLD, Chief Inspector of Rabbits, Department of Agriculture.

There are many vermin boards and settlers throughout the State who have done very good work during recent years in destroying rabbits, and have shown by their efforts that the pest can be kept within manageable limits so long as this good work is maintained.

Poisoning during the summer season is undoubtedly the most economical and efficacious method of keeping the pest in check, but fumigation is also necessary. This is mostly employed during the winter months. Any effort, however, to be successful requires continuous and thorough action; spasmodic effort is of little avail.

Unfortunately one cannot help noting that rabbits are increasing in certain areas, and it also causes grave concern to note the apathy and indifference many settlers and vermin boards display towards the pest in not taking action during the winter months. If efforts are only made during the summer months and nothing done during the winter, a serious position will rapidly develop, the pest definitely increasing. Therefore there is need for very definite action by all concerned, not only for a certain period but throughout the whole of the year.

The winter and spring months constitute the main breeding period for rabbits. Many people are under the erroneous impression that poisoning is of no use when any green feed is available, and cease all operations, thus leaving the pest unmolested to breed up again, and undoing the good work done during the summer.

It should be remembered that most of the damage to crops by rabbits is done whilst the crop is growing and the rabbits are breeding, little or no damage being done in what is usually regarded as the poisoning season, for the simple reason that the crop has been harvested.

It has been proved often enough by those who have tried that rabbits can be poisoned during the winter and spring months, especially after green feed has been available for a few weeks, rabbits in common with all other animals welcoming a change of food.

In addition to poisoning, fumigation of burrows can be carried out, and this method of wholesale destruction is particularly effective during the winter and spring, as not only are the rabbits more likely to be in the burrows, but the ground itself is more retentive of the gases or fumes used.

On fine bright days in winter and spring, burrows should not be fumigated unless the rabbits have been chased into them from the crop and scrub or other cover where they are almost sure to be, especially if the previous night has been wet and rough. Neglect of this precaution causes waste of much time, labour, and material, and leads many settlers to declare that the machine, the material, or fumigation itself as a method of destruction, is non-effective.

On account of the large amount of surface cover, such as scrub, dead timber, hollow logs on some holdings, it is impossible to get all rabbits into the burrows. For this reason poisoning should also be undertaken in conjunction with fumigation, as this will tend to prevent stray rabbits from opening up the warrens. Both fumigation and poisoning should be continued for a few days in order to achieve best results. By this means it is possible to keep rabbits in check.

To be successful, every method should be applied thoroughly and continuously, and if co-operative effort is undertaken on systematic lines good results will accrue.

WILD TURNIP.

(Brassica tournefortii.)

METHODS OF CONTROL.

N. DAVENPORT, Agricultural Adviser.

Now that seeding operations are nearing completion, farmers generally will be concentrating their activities on the preparation of the seed bed for next season's crop and, therefore, the problem of weed-control on the fallow will follow as a natural corollary. In this connection the pasturing of sheep both before and after the land has been fallowed will materially assist, as the sheep will check weed growth and permit of the implements used to deal more effectively with them.

All weeds in a crop are objectionable. There are some, however, which because of peculiar characteristics are particularly objectionable on the wheat farm, and their control is much more essential.

Of these, the wild turnip (*Brassica tournefortii*) is probably the most serious, and during the last few years it has spread to an alarming extent. It is a prolific seeding annual, and many thousands of seeds are produced from a single matured plant. The main stalk of the plant, when mature, is of a pithy nature and very brittle, so much so that the plants are easily broken off at the base and blown along the ground by the wind. In this manner the seeds of a single plant are distributed over a considerable area.

It is imperative, therefore, that every endeavour be made to control this weed. Not only are reduced yields obtained, but harvesting operations are made most difficult.

In common with other weeds, wild turnip is most easily controlled in the early stages of growth, and every effort should be made at eradication before seeds have been formed. This is particularly necessary on land lying in fallow, which will carry the next crop. If only comparatively few plants are permitted to reach maturity thereon, a considerable growth of the weeds will result the following season.

It is recommended that after the land has been fallowed, any young plants making their appearance should be destroyed by cultivation. It is not sufficient to simply run over the land, but the implement should be so adjusted and operated as to ensure that the young plants are uprooted, and where one cultivation is not sufficient, a further cross cultivation should be given. Where the plants are not

EXPLANATION OF PLATE.

A. Leaf (half natural size). B. Young plant, showing primary and secondary leaves. C. Illustrating part of an inflorescence, and the general habit of the summit of the plant when in seed. D. Siliqua viewed from the side showing the beak and dorsal nerve of one valve. E. Section showing a siliqua with one valve removed and the seeds in position. F. View showing the ripe siliqua with the valves removed, the central partition with some of the seeds in situ, and the persistent beak. (Icon. origin.)

sufficiently numerous to warrant cultivation, they should be hand pulled; many hours of labour will thus be avoided at a later stage. Plants pulled after they have reached the flowering stage should be removed in bags and either burned or buried deeply. This plant has a strong tendency to seed under adverse conditions, and plants pulled when quite green have been known to form seeds.

Activities directed towards the control of this weed should not be confined to fallowed land. As previously mentioned, matured plants are easily blown about from one part of the farm to another, and therefore it becomes necessary to keep them under control over the whole area, particular attention being paid to eradication along headlands and fence-lines.

One of the most common means of distribution of the seeds is the feeding of chaff and hay from infected crops. Crops intended for hay should be inspected and thoroughly rogued to ensure that the hay is free from these plants. Other sources of indirect infection are second-hand wheat bags which have previously contained wheat from an infected farm, and machinery which has previously been used on an infected holding.

This weed has proved such a potential danger to the wheat farmer that is has been gazetted a noxious weed under the "Noxious Weeds Act" over the whole State. In at least one instance the local authority considered it necessary to enforce its power under this Act to quarantine a farmer's holding. This means that before this farmer can remove his produce from his holding he must receive directions as to its disposal. This will indicate to farmers in districts where this weed is not yet prevalent the seriousness of the pest and the importance of preventing its becoming established.

LIVE STOCK AND MEAT.

The following information has been kindly supplied by Messrs. Elder, Smith & Co. Ltd., Perth:—

COMPARATIVE NUMBERS OF STOCK SOLD AT METROPOLITAN FAT STOCK MARKETS FOR MONTHS OF MARCH, APRIL AND MAY, 1934.

	March.				April.				May.				
	7th.	14th.	21st.	28th.	4th.	11th.	18th.	24th.	2nd.	9th.	16th.	23rd.	30th.
Sheep ...	12,331	10,051	8,919	8,920	6,298	9,698	10,017	9,169	10,194	9,388	8,654	8,413	10,167
Cattle ...	708	742	715	611	306	680	628	728	657	499	553	595	687
Pigs	1,448	1,630	1,473	1,079	952	1,762	1,038	958	1,605	1,244	1,077	1,614	1,898

COMPARATIVE VALUES PER POUND.

	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
Mutton ...	4½	4½	5	5	6½	6½	6½	5½	5½	5¼	5¼	5¼	5
Beef ...	4½	4½	4½	5	5	4¾	5	5	5	5¼	5¾	5¼	4¾
Pork	6½	5¾	5½	6½	6½	6½	6¾	6¾	6¾	6¾	6¾	6¾	6¾
Bacon ...	6	6	6	6	6	6	6	6	6	6	6	6	6

METEOROLOGICAL INFORMATION.

STATIONS.	TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.	
	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.
	Mean.	Highest.	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.		
	MARCH, 1934.						APRIL, 1934.						MAY, 1934.					
					inches.	inches.					inches.	inches.					inches.	inches.
Chapman State Farm	88·0	107·7	67·0	58·7	4·54	0·48	76·2	80·2	...	...	4·61	0·66	77·7	86·6	43·5	42·8	0·65	2·70
Geraldton	85·5	98·0	68·8	57·8	6·66	0·47	78·1	82·5	60·9	55·8	3·44	0·81	77·6	87·5	52·1	59·9	1·53	2·81
Walebing	86·1	109·0	62·8	51·1	4·80	0·76	72·7	82·8	53·4	45·1	2·77	0·89	73·7	84·0	49·4	38·0	1·80	2·65
Perth	82·5	100·6	65·2	56·2	5·71	0·77	73·9	80·0	57·2	52·6	1·28	1·69	73·3	84·4	56·5	41·8	4·88	5·11
Kalamunda	81·2	101·7	62·0	51·7	6·68	0·82	71·8	79·7	56·1	50·2	1·42	2·02	70·4	82·2	55·8	44·7	5·97	6·25
Bunbury	80·9	93·6	58·9	42·0	1·64	0·98	74·4	81·1	52·6	41·2	0·65	1·71	71·5	80·2	53·3	39·1	5·47	5·20
Bridgetown	82·3	103·5	53·7	36·8	2·43	1·04	75·6	86·0	45·6	32·2	0·38	1·72	72·7	86·0	44·8	35·5	3·85	4·62
Albany	74·5	91·0	60·0	50·3	5·47	1·54	70·2	75·3	55·4	47·0	4·36	2·77	69·7	83·8	51·9	44·8	2·51	5·03
Merredin State Farm	86·5	109·6	62·2	50·8	1·45	0·52	71·5	80·5	53·0	44·0	1·48	0·98	...	...	...	...	0·25	0·78
Northam	85·7	109·0	61·5	52·0	7·44	0·72	73·6	80·8	52·1	41·0	2·80	0·82	73·6	86·0	49·6	40·0	2·33	2·31
York	84·1	108·0	61·1	50·0	7·95	0·64	72·4	78·5	51·7	40·5	3·63	0·81	71·8	83·5	48·8	34·0	3·04	2·38
Narrogin State Farm	81·3	104·3	56·8	45·4	6·68	0·52	70·3	78·0	49·3	39·9	1·62	0·79	69·0	81·0	48·7	34·0	2·67	1·19
Katanning	79·8	103·0	57·2	43·3	3·72	0·95	70·7	79·6	49·6	38·7	1·52	1·17	68·9	81·0	47·4	38·0	2·47	2·49
Cape Leeuwin ...	74·4	93·2	63·9	59·0	1·93	1·19	72·0	79·0	60·1	53·8	1·61	2·26	68·5	81·5	58·8	50·0	8·87	5·82

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This publication contains numerous illustrations, being reproduction of photographs taken in this State, of pruned and unpruned trees, which make the details set out in the letterpress particularly easy to understand. Price 2s. 6d.

Fruit Packing and the Marketing and Exporting of Fruit, by J. F. Moody, Fruit Industries Commissioner, and J. Ramage, Packing Instructor:

This publication contains invaluable information on packing and grading fruit for local and export markets. It is freely illustrated, and no fruit-packing shed should be without a copy. Price 1s. 6d.